WA 9751
4-10-89
17a

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

APR 1 0 1989

RECEIVED
APR 1 2 1989
Ans'd............

REPLY TO ATTN OF: HW-112

CERTIFIED MAIL - RETURN RECEIPT REQUESTED

Doug Hardesty
Hillman Properties Northwest
2000 E. Columbia Way
Vancouver, Washington 98661

Re: Notice of Deficiency for Building #5 Closure Plan

Dear Mr. Hardesty:

The U.S. Environmental Protection Agency (EPA) Region 10, Waste Management Branch and Washington Operations Office have reviewed the closure plan submitted by Hillman Properties Northwest for performance of the Resource Conservation and Recovery Act (RCRA) at Building 5 in the Columbia Industrial Park, Vancouver, Washington. This review was performed pursuant to Consent Agreement and Final Order docket number 1088-01-01-3008 and 40 CFR 265 Subpart G. In addition, an in-depth review of the existing groundwater monitoring system for the site was conducted to assess its adequacy for certifying clean closure. This was done in accordance with 40 CFR 265 Subpart F. Both reviews uncovered deficiencies which must be corrected. We request that the closure plan be modified to fully address the following deficiencies.

- An estimate of the maximum inventory of hazardous wastes was not provided.

- The plan did not identify the transporter or the treatment or disposal facility that would be used should it be necessary to remove material from the site during closure.

- The plan does not contain a discussion of back filling procedures should removal of soil be necessary.

- The plan did not discuss site security during closure.

- A topographic map of the site was not provided with the plan.

- According to the plan, equipment decontamination rinsewaters will be discharged to the storm sewer. A sampling plan for sampling of the rinsates prior to discharge was not included in the closure plan.

- In the site history provided in the closure plan, Table 1-1 indicates that AGI found 1606 ppm of lead in grid A-5. Even though this area was excavated, this grid should be sampled again to confirm that it is clean.

- Current information provided to EPA on the groundwater monitoring system does not answer the following questions:

Dictated by Ecology

1. What criteria was used in selecting well placement and does the well network adequately cover the potentially contaminated area?

2. What is the nature, areal extent, and geometry of the silty gravel aquitard to the north and east of the site?

3. Where are the buried utility lines crossing the land disposal area and what role do these lines play in contaminant migration at the site?

none

4. Is the hydraulic fill aquifer the uppermost aquifer?

5. What is the potential for contaminant migration along the fill/silty gravel contact?

6. What is the direction of groundwater flow across the site during high water periods (winter and spring)?

7. What is the total thickness of the sand aquifer?

This information is needed to determine the adequacy of the existing system for sampling of the groundwater to certify clean closure.

The revised closure plan should be submitted to EPA, Region 10, within 45 days of your receipt of this letter.

If you have any questions contact Jack Boller at (206) 753-9428.

All submittals must be sent to:

C.A. Shenk, Chief
RCRA Compliance Section
Environmental Protection Agency
1200 Sixth Avenue (HW-112)
Seattle, Washington 98101

Sincerely,

Michael F. Gearheard, Chief
Waste Management Branch

DAMES & MOORE A PROFESSIONAL LIMITED PARTNERSHIP

1220 S.W. MORRISON ST., SUITE 404, PORTLAND, OREGON 97205 2260 (503) 225 7655

May 24, 1989

Environmental Protection Agency
RCRA Compliance Section
1200 Sixth Avenue (HW-112)
Vancouver, Washington 98661

Attention: Mr. C. A. Shenk

Response to EPA Comments
Columbia Industrial Park Closure Plan
Vancouver, Washington

Dear Mr. Shenk,

This letter includes clarifications of the deficiencies in the Building No. 5 Closure Plan noted by the EPA in a letter dated April 10, 1989. The deficiencies will be numbered and addressed in order.

The EPA requested clarifications are as follows:

1. The maximum inventory of hazardous waste can not be determined from the available information. The available records of Cascade Temperings waste disposal practices and production process would not provide meaningful estimates of this volume.

2. A qualified waste transporter will be selected after closure plan acceptance and with consideration of availability and cost. The disposal facility will be determined based on the excavated soils designation. Non-dangerous wastes will be disposed locally at a minimum function design landfill such as the Circle C landfill. Dangerous wastes will be disposed of at a either CSSI-Arlington or ESI-Idaho.

3. Backfill procedures will be conducted to achieve the goals specified in section 1.5.7 of the Closure Plan. Imported clean fill will be placed and compacted to specifications required for use as a parking and truck loading area.

4. The area affected by excavation will be barricaded and surrounded by caution tape. The industrial parks 24 hour security service will be alerted to prevent entry to this area.

5. The topography of the affected area is essentially flat lying. Spot elevations are indicated on the attached utilities plan (Figure 1).

6. Equipment will be decontaminated in a bermed tarp covered area. The waste water will be decanted to a drum as needed and sampled prior to disposal. This will increase sample analysis and materials costs approximately $450.

7. In response to EPA concerns, a sample was collected from a depth of two feet in grid area A-5 on May 2, 1989. A total lead concentration of 1.7 ppm was determined and demonstrates that the contaminated soil has been removed. Background levels for lead in these soils range from 32 to 135 ppm as discribed in Section 1.5.2.1 of the Closure Plan. The laboratory report is attached.

8-1. In consultation with the WDOE it was decided that monitoring wells would be placed at one upgradient and three downgradient locations. The first wells (CT-2 to CT-4) were located with the concurrence of DOE representative Joanne Chance and designed to monitor the fill material. The second set of wells (AGI-1 to AGI-4) were designed to monitor the sand aquifer. Plate 11 in the AGI report demonstrates that these wells satisfy the one up- and three downgradient criterion. Additionally, this flow direction is reported as dominant at the Frontier Hard Chrome site to the north. Further discussion of the adequacy of the network will be included with clarifications of deficiencies 8-2, 8-4, 8-5, and 8-6.

8-2. The lithologic information obtained during investigation of Frontier Hard Chrome (approximately 1500 feet north of Building 5) indicates that the silty gravel unit is laterally extensive north, northeast and west of Building 5. It can be assumed to extend to the east and south as well. At Frontier Hard Chrome, this unit is described as being of relatively low permeability while an overlying silt and clay unit is considered an aquitard. At Building 5, the conditions appear similar because the silty gravel does not perch water in the overlying fill. This unit can, therefore, be considered an aquitard only in a relative sense at this site.

8-3. A utility plan for the industrial park has been reviewed. A copy of the relevant section is attached (Figure 1). Water and gas lines are present on the east and west sides of the waste disposal area respectively but do not cross this area directly. Additionally, no evidence of abandoned utilities was noted during the investigations or excavations of affected soils.

8-4. Water level measurements taken in shallow wells CT-2 and CT-3 in February 1985, July 1986 and May 1989 (Table 1) all indicate that the fill was not saturated and, therefore, should not be considered the uppermost aquifer. These measurements represent wet and dry season water levels all of which are below the described base of the fill.

8.5. There is little potential for horizontal contamination migration along the fill/silty gravel contact in that the fill is not saturated.

Infiltration and migration of contaminants will be primarily along vertical pathways. Ground water is assumed to be the primary carrier of any contaminants. Additionally, the silt content of the material may retard migration of lead by absorption.

8-6. Water levels measured in the sand aquifer at the site on May 2nd 1989 indicate water levels approximately two and a half feet higher than the July, 1986 water levels and a westward gradient. A correlation between aquifer water levels and Columbia River stage is described at Frontier Hard Chrome for this aquifer. River stage is shown to have a dominant effect on aquifer water levels and gradients. However, the predominant slope of the potentiometric surface is reported to be to the south-southeast. The average river stage is highest during May and June which indicates that gradients measured during these months may not define average flow direction and, therefore, contaminant migration direction. The primary contaminant migration direction at the site is considered to be to the south.

8-7. The total thickness of the sand aquifer at the site is not known. The alluvial material present in the flood plain of the Columbia River generally contains interbeds, lenses, and mixtures of gravel, sand, silt and clay. This material character is described near the site at Frontier Hard Chrome. Vertical groundwater flow and, therefore, vertical contaminant dispersion within the saturated zone is limited by the layered nature of this material. Additionally, a vertical ground-water gradient which would act to drive water downward was not measured at Frontier Chrome. The ground-water samples to be obtained at the site are, therefore, considered representative of this aquifer.

We expect that this information addresses the concerns of the EPA for these deficiencies. If you have any questions please contact me directly.

Yours very truly,

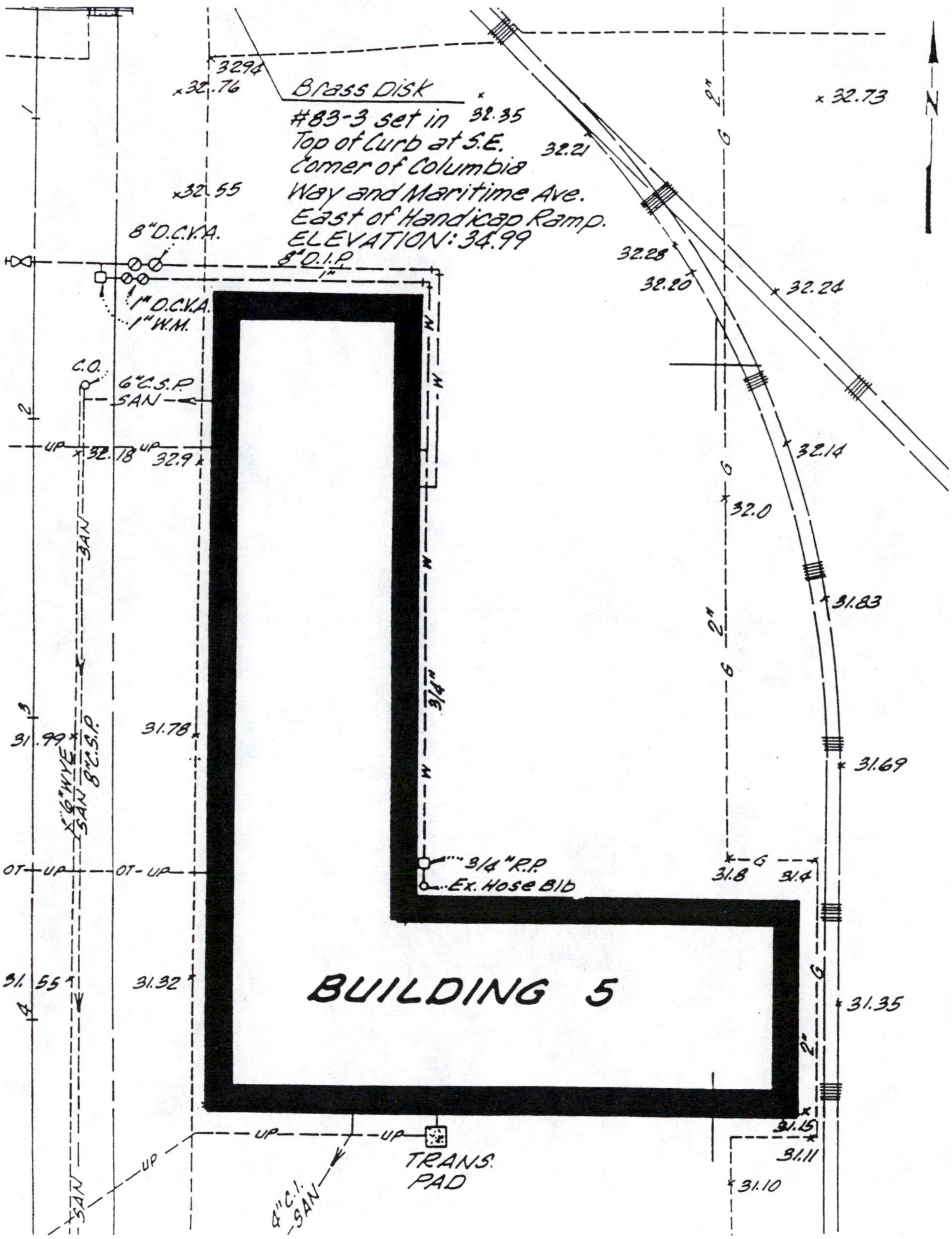
DAMES & MOORE

Kim L Marcus

Kim L. Marcus,
Senior Geologist

WD44/Hill
DRD:cad
17809-001-005

cc: Jack Boller, EPA



UTILITY PLAN

COLUMBIA INDUSTRIAL PARK, BUILDING 5 WASTE DISPOSAL AREA CLOSURE

DAMES & MOORE
MAY 1989

JOB NO: 17809-002-001

FIGURE 1

HILLMAN PROPERTIES
VANCOUVER, WASHINGTON
JOB NO: 17809-001

TABLE 1
WATER LEVELS
May 2, 1989

WELL TESTED	TIME	DEPTH to WATER (in feet)	WATER LEVEL ELEVATION*
CT-2	12:38	11.58	14.56
CT-3	12:43	8.42	17.46
CT-4	13:03	21.89	5.33
AGI-1	13:34	22.97	2.36
AGI-2	12:34	23.05	2.33
AGI-3	12:46	22.53	2.27
AGI-4	--	--	--

NOTE: * = Relative to AGI Arbitrary Site Datum

Analytical Technologies, Inc. Corporate Offices: 5550 Morehouse Drive San Diego, CA 92121 (619) 458-9141

ATI I.D. 905057

May 10, 1989

Dames & Moore
1220 S.W. Morrison Street, Suite 404
Portland, Oregon 97205

Project No: 17809-001

Project Name: Hillman Prop.

Attention: Dennis Dykes

On May 4, 1989, Analytical Technologies, Inc. received one soil sample for analyses. The sample was analyzed with EPA methodology or equivalent methods as specified in the attached analytical schedule. The symbol for "less than" indicates a value below the reportable detection limit. Please see the attached sheet for the sample cross reference.

The results of these analyses and the quality control data are enclosed.

For: Marcilen Lindsey
Senior Project Manager

Richard M. Amano
Laboratory Manager

ML:lap

Analytical**Technologies**,Inc.

ATI I.D. 905057

ANALYTICAL SCHEDULE

CLIENT: DAMES & MOORE
PROJECT NAME: HILLMAN PROP.

PROJECT NO.: 17809-001

ANALYSIS	TECHNIQUE	REFERENCE/METHOD
PERCENT MOISTURE	GRAVIMETRIC	METHOD 7-2.2 in Methods of Soil Analysis, American Society of Agronomy
LEAD	ICAP	EPA 6010

NOTE: All soil sample results were calculated in dry weight.

Analytical Technologies, Inc.

CLIENT : DAMES & MOORE-PORTLAND
PROJECT # : 17809-001
PROJECT NAME : HILLMAN PROP.

DATE RECEIVED : 05/04/89
REPORT DATE : 05/10/89

ATI I.D. : 905057

ATI #	CLIENT DESCRIPTION	MATRIX	DATE COLLECTED
01	CP-A5	SOIL	05/02/89

----- TOTALS -----

MATRIX	# SAMPLES
SOIL	1

ATI STANDARD DISPOSAL PRACTICE

The samples from this project will be disposed of in thirty (30) days from th date of this report. If an extended storage period is required, please contac our sample control department before the scheduled disposal date.

Analytical Technologies, Inc.

GENERAL CHEMISTRY RESULTS

ATI I.D. : 905057

CLIENT : DAMES & MOORE-PORTLAND
PROJECT # : 17809-001
PROJECT NAME : HILLMAN PROP.

DATE RECEIVED : 05/04/89

REPORT DATE : 05/10/89

PARAMETER	UNITS	01
% MOISTURE	%	5.7

Analytical Technologies, Inc. GENERAL CHEMISTRY - QUALITY CONTROL

CLIENT : DAMES & MOORE-PORTLAND
PROJECT # : 17809-001
PROJECT NAME : HILLMAN PROP.

ATI I.D. : 905057

PARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC	% REC
MOISTURE (%)		90508201	17.2	17.2	0	N/A	N/A	N/A

$$\% \text{ Recovery} = \frac{\text{(Spike Sample Result - Sample Result)}}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{\text{(Sample Result - Duplicate Result)}}{\text{Average Result}} \times 10$$

Analytical**Technologies,**Inc. METALS RESULTS

ATI I.D. : 905057

CLIENT : DAMES & MOORE-PORTLAND
PROJECT # : 17809-001
PROJECT NAME : HILLMAN PROP.

DATE RECEIVED : 05/04/89

REPORT DATE : 05/10/89

PARAMETER	UNITS	01
LEAD	MG/KG	1.7

Analytical**Technologies**,Inc.

METALS - QUALITY CONTROL

CLIENT : DAMES & MOORE-PORTLAND
PROJECT # : 17809-001
PROJECT NAME : HILLMAN PROP.

ATI I.D. : 905057

PARAMETER	UNITS	ATI I.D.	SAMPLE RESULT	DUP. RESULT	RPD	SPIKED SAMPLE	SPIKE CONC	% REC
LEAD	MG/KG	90508404	4.9	5.4	10	50.6	53.1	86

$$\% \text{ Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{\text{Spike Concentration}} \times 100$$

$$\text{RPD (Relative Percent Difference)} = \frac{(\text{Sample Result} - \text{Duplicate Result})}{\text{Average Result}} \times 1($$

558-2384 Fax FM

DAMES & MOORE

1220 S.W. Morrison Street, Suite 404 • Portland, Oregon 97205 • (503) 228-7688

Chain of Custody

Date 5/2/89 Page 1 of 1

Project Number: 17809-001
Project Manager: Dennis Dykes
Laboratory: ATI
Turn around time:

Sampler's Initials: JAJ
Sampler's Signature: Jean A Jenkins

Analysis Request

Sample ID	Date	Time	Matrix	Volatile Organics 624/8240 (GC/MS)	Halogenated Volatiles 601/8010	Aromatic Volatiles 602/8020	Base/Neutral/Acids 625/8270 (GC/MS)	BTX 602/8015	Polycyclic Aromatic Hydrocarbons 610/8310	Pesticides/PCBs 608/8080	Metals - Total Lead			Priority Pollutant Metals (13)	EP TOX Metals (8)			Comments/ Instructions	Number of Containers
CP-A5	5/2/89	13:45	Sand								X								

Special Instructions/Comments:

Relinquished by:
(Sig) Jean A Jenkins
(Printed) Jean A. Jenkins
(Company) Dames & Moore
(Time) 2:05 (Date) 5/3/89

Received by (lab):
(Sig)
(Printed)
(Company)
(Time) (Date)

Sample Receipt
Total no. of containers:
Chain of custody seals:
Rec'd good condition/cold:
Conforms to record:
Lab number:

Q-6

Applied Geotechnology Inc.

A Report Prepared for

Hayden Corporation
2000 E. Columbia Way
Vancouver, Washington 98661

SOIL CONTAMINATION INVESTIGATION
BUILDING 5, COLUMBIA INDUSTRIAL PARK
VANCOUVER, WASHINGTON

AGI Project No. 15,103.001

by

Mark A. Adams
Project Manager

Mackey Smith cag
Associate Hydrogeologist

APPLIED GEOTECHNOLOGY INC.
300 120th Avenue N.E., Building 4, Suite 215
Post Office Box 3885
Bellevue, Washington 98009
206/453-8383

and

2501 East "D" Street, Suite 215
Tacoma, Washington 98421
206/383-4380

October 10, 1986

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

APPENDICES

LIST OF ILLUSTRATIONS

INTRODUCTION

SITE CONDITIONS

SOIL CHEMISTRY

LIST OF TABLES

EXECUTIVE SUMMARY

Purpose

A field and laboratory investigation has been conducted in an area contaminated with lead and cadmium wastes from a glass tempering operation. The contaminated area is located next to Building 5 in the Columbia Industrial Park, Vancouver, Washington. Washington Department of Ecology (Ecology) requested the investigation to determine the extent of metals contamination and to determine if groundwater beneath the site has been impacted.

Nature of the Problem

Cascade Tempering Inc. and its predecessors conducted glass tempering operations at Building 5 from August 1980 to April 1984. The operation generated paint sludge and dust containing lead, cadmium, and other metals. The sludge was discharged into a drywell adjacent to Building 5 and both sludge and dust were dispersed throughout the parking lot on the northeast side of Building 5. This area is referred to as the "waste disposal" area.

Ecology collected soil samples from the waste disposal area in October, 1984, and determined the soils were a Dangerous Waste under Washington State Dangerous Waste Regulations (WAC 173-303). Based on this Ecology data and some additional chemical testing, visually contaminated soils were removed in February and July, 1985, and transported to the secure landfill at Arlington, Oregon. The drywell and surrounding soil were also removed and taken to Arlington. Subsequent chemical testing indicated high concentrations of lead remained in soils in the waste disposal area. Ecology consequently requested this investigation to more fully define the extent of lead contamination as the basis for additional cleanup, if appropriate.

Investigation Summary

The investigation consisted of an extensive field exploration and sampling program including collection and analysis of sixty (60) soil samples, and installation and sampling of four (4) groundwater monitoring wells. Soil chemistry and water quality data from previous investigations was also available and was utilized as appropriate.

The soil samples were collected at four depth intervals (0 to 1, 1 to 3, 3 to 6, and 6 to 10 feet) from within and outside of the waste disposal area. The outside samples were used to define background conditions for each depth interval. Lead concentrations in the waste disposal area were then statistically compared with the background concentration for each depth interval to determine whether they exceeded background. The Wilcoxin Rank Sum non-parametric test was chosen for the statistical test and 95% was chosen as the significance level.

The impact of the waste disposal area on groundwater was evaluated by comparing lead and cadmium concentrations in up and downgradient wells. Cadmium and lead were chosen for analysis as they were present in highest concentration in the paint waste.

Findings

Soil Contamination: The analytical data shows a uniform elevation in mean lead concentrations in the waste disposal area relative to background concentrations for all depth intervals. However, the two areas cannot be statistically distinguished at the 95% significance level, except for the 6 to 10 foot depth interval. Waste area lead concentrations for this depth interval appear to be statistically higher than background. However, the difference appears to be due more to sampling different geologic deposits than to actual contamination differences.

Technically, the analytic data and statistical comparisons indicate no difference between the waste disposal area and background and hence no need for additional remedial actions. However, we believe it would be appropriate to remove soil in four areas where lead concentrations are clearly higher than adjacent areas.

Groundwater Quality: No impact to groundwater was detected.

1.0 INTRODUCTION

1.1 General

This report presents the results of our field and laboratory investigation of an area near Building 5 in the Columbia Industrial Park which was contaminated with lead and cadmium waste from a glass tempering operation. The Columbia Industrial Park (CIP) is located in Vancouver, Washington, on the north bank of the Columbia River, as shown on the Vicinity Map, Plate 1. The contaminated area ("waste disposal" area) is generally located between the northern and eastern arms of Building 5, as shown on Plate 2, Site Features.

1.2 Purpose and Scope

The Washington State Department of Ecology (Ecology) has requested the disposal site be cleaned up as both lead and cadmium are known toxic substances. Accordingly, the purpose of our investigation was to define the extent of lead in soil and to determine whether groundwater quality beneath the disposal site has been impacted by past disposal practices. This information would be used to develop a Cleanup Plan.

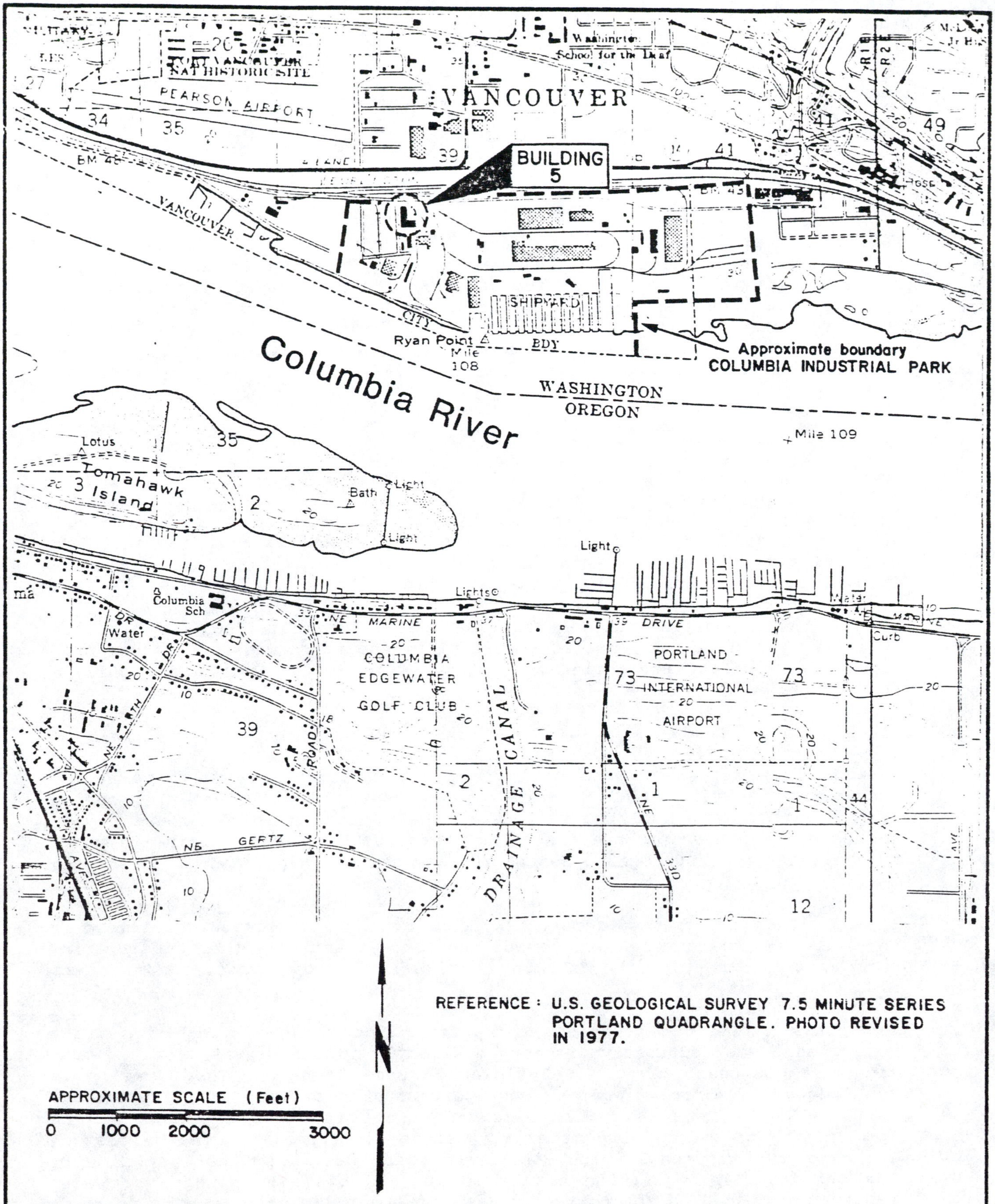
To guide the investigation, a Work Plan, dated June 10, 1986, was prepared detailing field sampling procedures, Quality Assurance/Quality Control protocols, and safety precautions. Ecology reviewed the Plan and signified their approval in a July 7 letter.

1.3 Background

Cascade Tempering Inc. and its predecessors conducted glass tempering operations at Building No. 5 from August 1980 to April 1984. The operations consisted of applying various specialty paints to glass and drying the paint with electric heaters. The glass was then wiped clean, tempered in a furnace at 1100 to 1300 degrees F, and passed through an air quenching unit.

The specialty paints were reportedly comprised of approximately 50% lead in the form of inorganic lead compounds and 1 to 2% each of other cobalt, zirconium, chromium, nickel, antimony, and selenium compounds. Cadmium was also present at 5%.

The glass tempering operations generated paint residue sludge and dust. Some sludge was reportedly discharged directly into a drywell located outside the northeast corner of Building 5 (see Plate 2). The drywell was constructed of 4-foot diameter concrete casing installed to an approximate depth of 8 feet. The drywell received runoff from the adjacent parking lot. Dust and other waste materials became dispersed through the parking lot from two air vents which discharged paint dust from the east side of the building. Many leaking or tipped buckets of paint sludge were also reportedly stored on the northeast side of the building. As a consequence of these activities, subsurface soils around the drywell and surface soils on the northeast side of Building 5 were contaminated with paint residue.



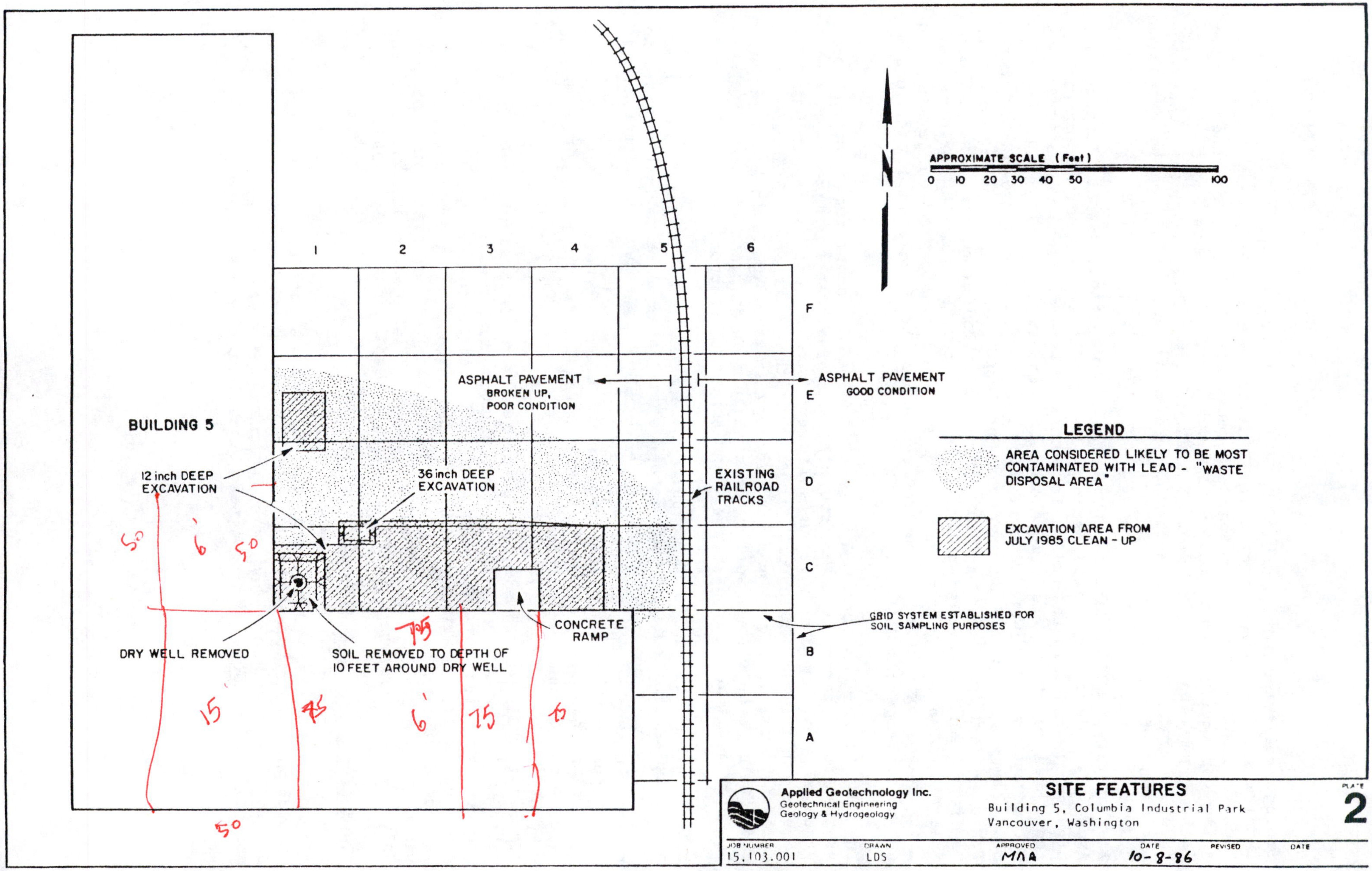
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

VICINITY MAP

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE 1

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15.103.001	LDS	MAA	10-8-86		



2,083
555
833
3471

Ecology collected soil samples from the area on October 30, 1984. Both cadmium and lead were detected in EP Toxicity test extracts at concentrations above State of Washington Dangerous Waste limits. Consequently, the soils were designated a Dangerous Waste pursuant to Washington Dangerous Waste Regulations (173-303 WAC). Ecology subsequently requested that Cascade Tempering initiate a soil and groundwater investigation to determine the extent of contamination.

In February, 1985, Cascade Tempering's consultant, Sweet Edwards and Associates, began an initial site investigation and a preliminary cleanup of visually contaminated soil. Four borings were drilled around Building 5 and three of them were completed as groundwater monitoring wells. Two groundwater samples were obtained from the wells and analyzed for lead. Soil samples from the borings were analyzed for eight metals using EP Toxicity Test procedures. Thirty-four 55-gallon drums of visually contaminated soil were also collected and composited for EP Toxicity test analysis. The analytic results from the drum samples showed cadmium and lead in the extract at concentrations above the 5 mg/l limit for designation as Dangerous Waste.

In July 1985, Chem Security Systems Inc. (CSSI) completed a second more substantial cleanup of the waste disposal area. Approximately 125 cubic yards of visually contaminated soil were removed and transported to the secure landfill at Arlington, Oregon, and the interior of Building 5 was decontaminated in accordance with Ecology instructions. In addition, the concrete drywell and all soil in an area 10 feet deep and 15 feet in diameter around the drywell was removed and sent to Arlington.

Prior to the cleanup, CSSI consultant Dames & Moore obtained 10 surface soil samples from outside the waste disposal area to establish background lead concentrations. Following cleanup, they obtained an additional 10 background samples and a number of composite samples from the cleanup area. The purpose of the latter sampling was to determine whether background concentrations had been achieved. Analytic results from these samples showed high concentrations of lead remained in the cleanup area.

After the CSSI cleanup had been completed, the new analytic results indicated some unknown volume of contaminated soil remained. Accordingly, Ecology requested in a November 27, 1985, letter that a detailed plan be prepared to systematically evaluate the extent of this contamination. Cascade Tempering became insolvent before a detailed plan could be prepared. Consequently, AGI prepared the Work Plan referred to earlier for Columbia Industrial Park, and began field operations in July, 1986.

1.4 Investigation Summary

Information necessary to develop and implement a Cleanup Plan was obtained through an extensive field exploration and sampling program. The program consisted of two parts: soil sampling and groundwater monitoring. The purpose of soil sampling was to obtain sufficient data to define the vertical and lateral extent of metals contamination. The purpose of groundwater monitoring was to define the hydrogeologic setting and to determine whether there had been any impacts to groundwater from the waste disposal area. Specific details of the two programs are discussed below.

Soil Sampling

Sixty soil samples were obtained in July, 1986, as composites from depths of 0 to 1 foot, 1 to 3 feet, 3 to 6 feet, and 6 to 10 feet, at the locations shown on Plates 3, 6, 7, and 8, respectively. The samples were collected from within a predetermined grid established within and outside of the area considered most likely to be most contaminated with metals (i.e., waste disposal area). Soil samples were also collected from groundwater monitoring well borings. The grid system consists of squares each measuring 30 x 30 feet, as shown on the sample location plates. Samples from 0 to 1 foot depth were obtained with a post hole digger or an auger drill and composited from four locations within each grid square. Deeper samples were composited from two auger borings in each grid square. For a complete description of sampling and compositing procedures, refer to Appendix A. Logs of the post hole and auger borings are presented in Appendix B.

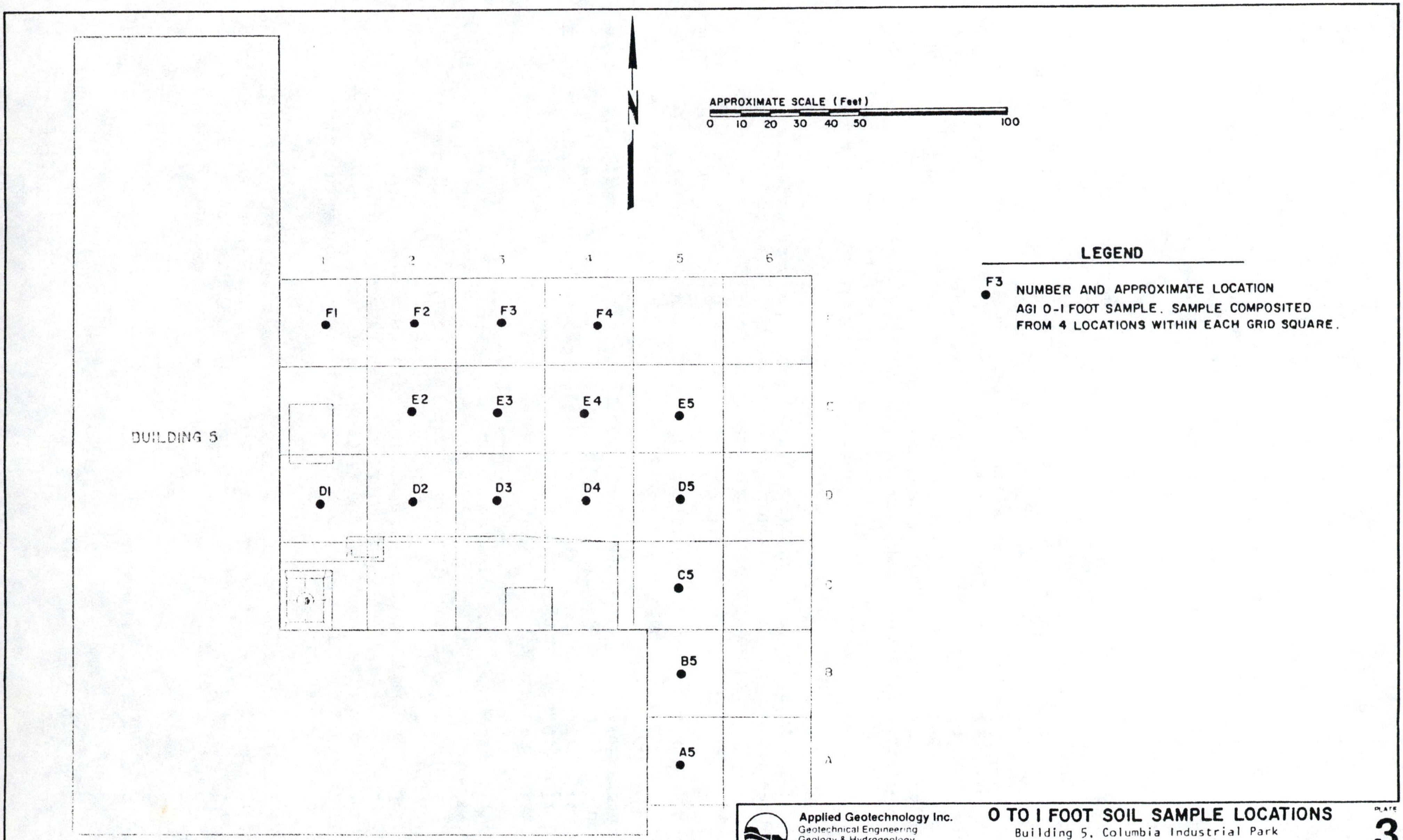
Plates 4 and 5 show the location of 20 "BR" and "BG" surface soil samples obtained in 1985 by Dames & Moore. These samples were collected from a wide area around the waste disposal area to define background lead concentrations. The analytic results were submitted to WDOE and were accepted by WDOE as representative of surface soil background lead concentrations.

Dames & Moore collected an additional nine samples on July 25 from the drywell excavation; four were taken from the upper half of the excavation, four from the lower half, and one from the base. These samples were reportedly taken from the bucket of a backhoe after it had scraped the side of the excavation. Consequently, the samples are neither true composites nor true discrete samples. The upper sample locations are shown on Plate 7 and the lower sample locations are shown on Plate 8. The base sample is also shown on Plate 8.

One other sample was also collected on July 25 from the base of a 1-foot deep excavation around a downspout on the south side of Building 5. The soil had been removed in this area as part of the July 1985 cleanup.

Thirteen additional samples were collected by Dames & Moore on July 29, 1986, from the base of the area where soil was removed during the July 1985 cleanup. The average depth of excavation was 1 foot, so these 13 samples represent conditions in the 1 to 2 foot depth range. July 29 sample locations are shown on Plate 6.

All of the AGI and Dames & Moore soil samples were analyzed for total lead and percent moisture, although Dames & Moore did not report the percentage moisture. The Analytic Schedule for soils is presented on Table 1 and a summary listing of all soil samples is presented on Table 2, Soil Sample Summary.



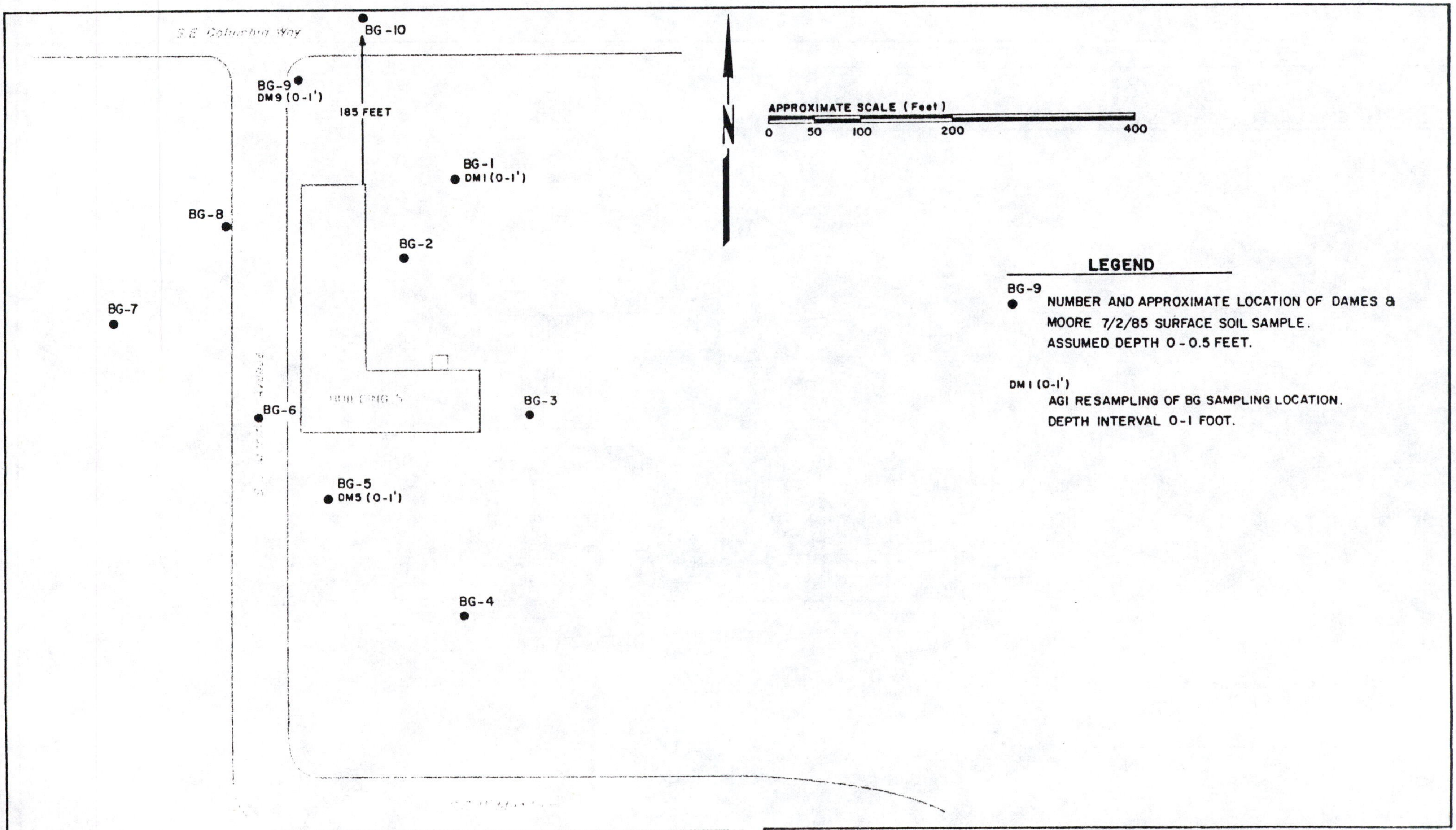
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

0 TO 1 FOOT SOIL SAMPLE LOCATIONS

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE 3

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		



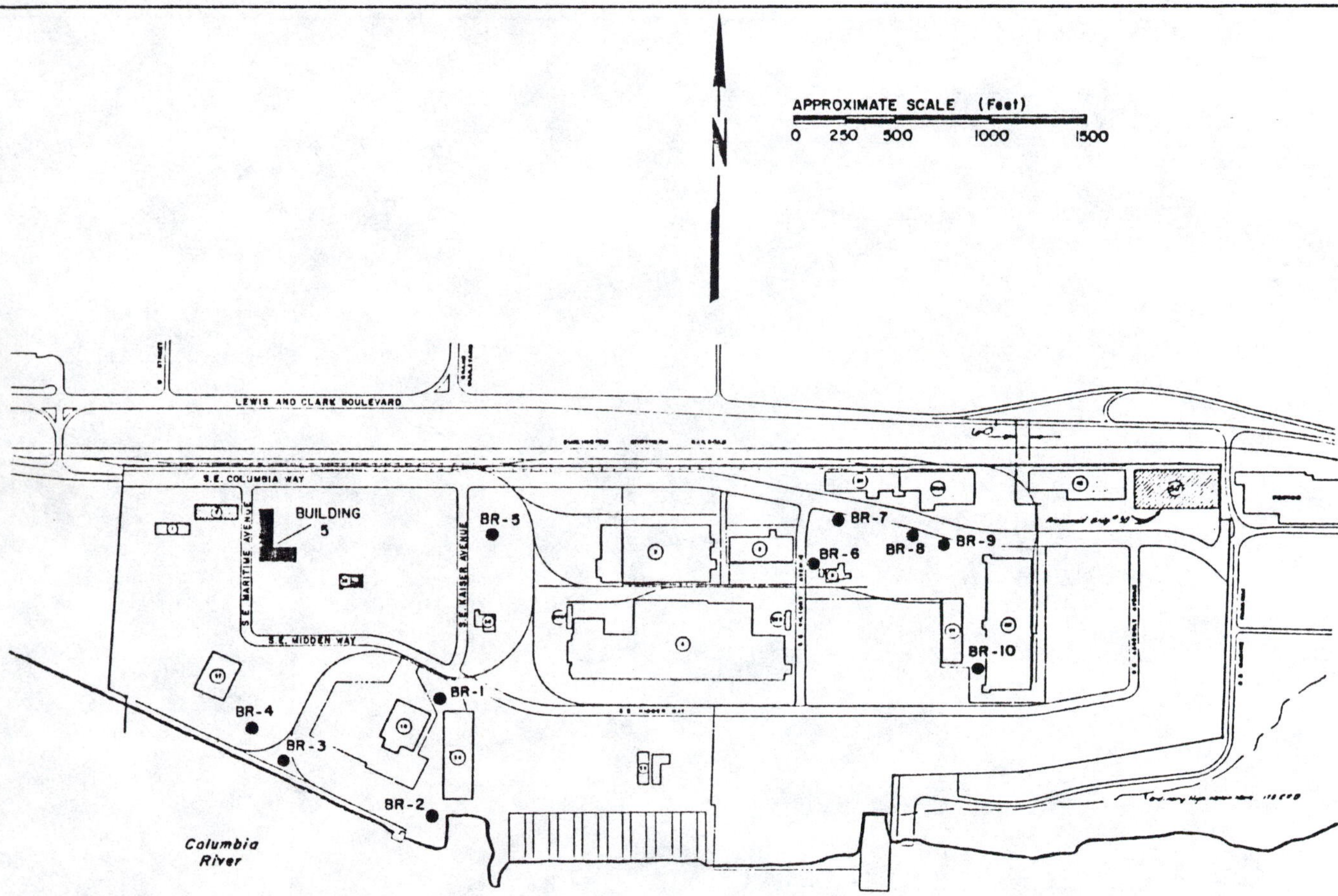
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

BG SAMPLE LOCATIONS

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **4**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		



LEGEND

● BR-10 NUMBER AND APPROXIMATE LOCATION OF DAMES & MOORE 7/29/85 SURFACE SOIL SAMPLE. ASSUMED DEPTH 0-0.5 FEET.

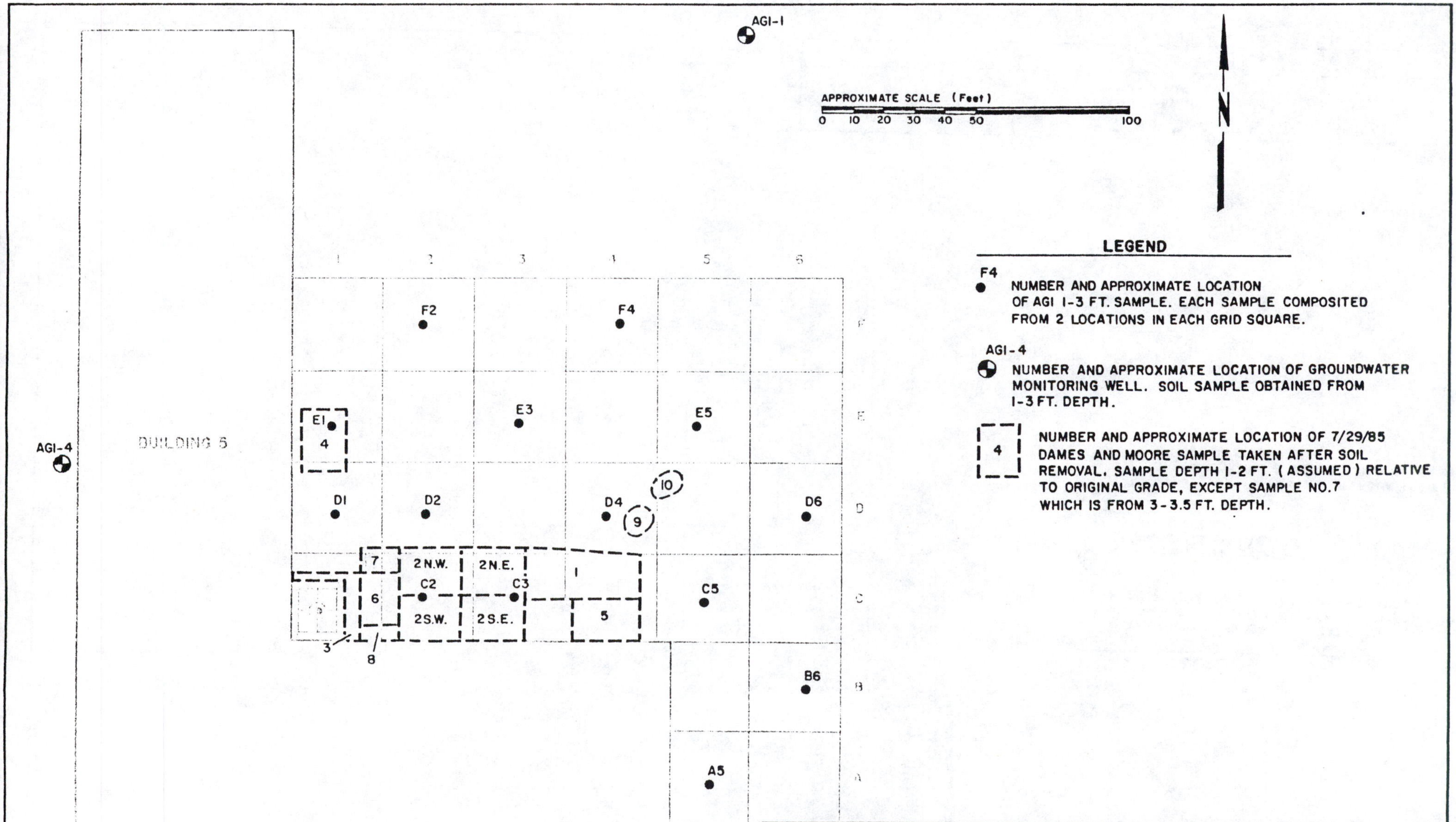
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

BR SAMPLE LOCATIONS

Bulding 5, Columbia Industrial Park
Vancouver, Washington

PLATE 5

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-96		

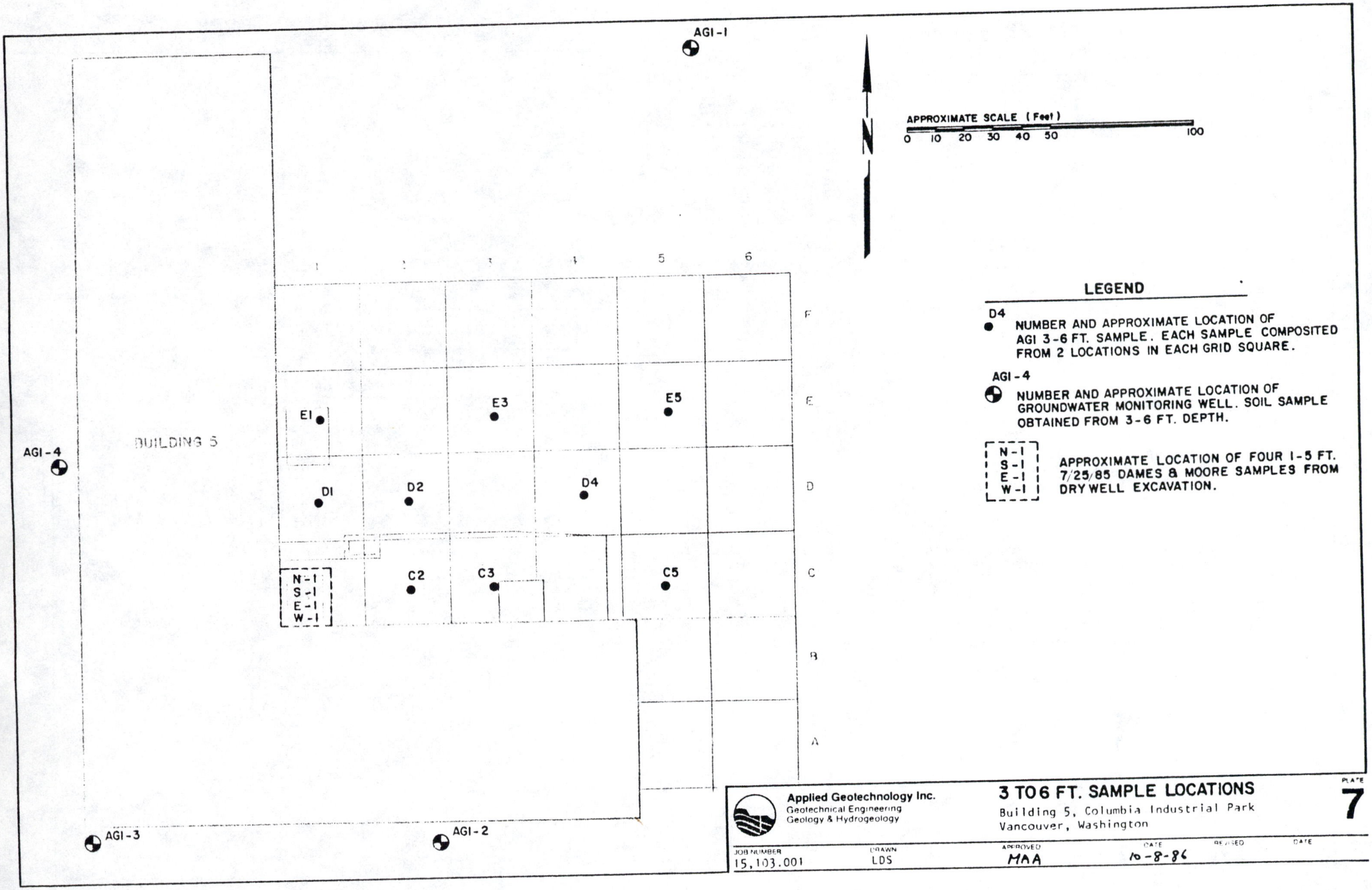


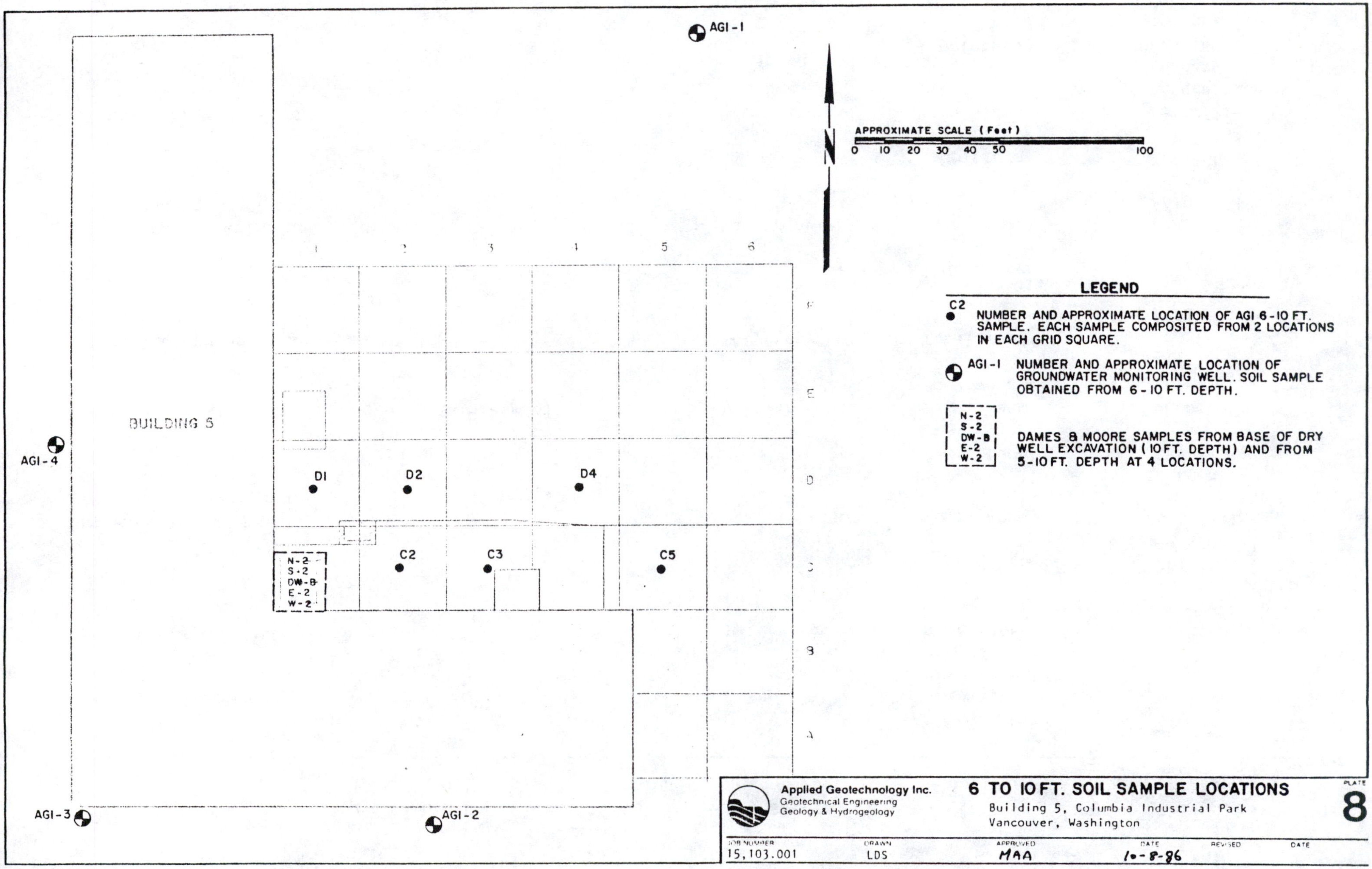
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

1 TO 3 FT. SAMPLE LOCATIONS
Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE
6

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	1-8-86		


AGI-1
APPROXIMATE SCALE (Feet)
0 10 20 30 40 50 100
N
1 2 3 4 5 6
F
E
D
C
B
A
E1
E3
E5
D1
D2
D4
C2
C3
C5
BUILDING 5
AGI-4
N-1
S-1
E-1
W-1
AGI-3
AGI-2
LEGEND
D4
NUMBER AND APPROXIMATE LOCATION OF AGI 3-6 FT. SAMPLE. EACH SAMPLE COMPOSITED FROM 2 LOCATIONS IN EACH GRID SQUARE.
AGI-4
NUMBER AND APPROXIMATE LOCATION OF GROUNDWATER MONITORING WELL. SOIL SAMPLE OBTAINED FROM 3-6 FT. DEPTH.
N-1
S-1
E-1
W-1
APPROXIMATE LOCATION OF FOUR 1-5 FT. 7/25/85 DAMES & MOORE SAMPLES FROM DRY WELL EXCAVATION.
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology
3 TO 6 FT. SAMPLE LOCATIONS
Building 5, Columbia Industrial Park
Vancouver, Washington
PLATE
7
JOB NUMBER
15,103.001
DRAWN
LDS
APPROVED
MAA
DATE
10-8-86
REVISED
DATE



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

6 TO 10 FT. SOIL SAMPLE LOCATIONS

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE 8

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		

TABLE 1: ANALYTIC SCHEDULE: SOILS

Applied Geotechnology Inc.

Source[1)]	Sample Depth (Feet)	Number of Samples	Sample Container	Analysis	Analytic Method
D&M BR, BG Samples	0 - .5 (assumed)	20	Unknown	Total lead (dry weight)	Unknown
AGI grid squares	0 - 1	16	Polypropylene	Total lead	EPA 7421- AA graphite furnace
				% Moisture	EPA 160
AGI resampling of D&M BG sample locations	0 - 1	3	Polypropylene	Total Lead	EPA 7421- AA graphite furnace
				% Moisture	EPA 160
D&M sampling after cleanup	1 - 2.0 (assumed)	13	Unknown	Total lead (dry weight)	Unknown
AGI monitoring wells and grid squares	1 - 3	18	Polypropylene	Total lead	EPA 7421- AA graphite furnace
				% Moisture	EPA 160
AGI monitoring wells and grid squares	3 - 6	13	Polypropylene	Total lead	EPA 7421- AA graphite furnace
				% Moisture	EPA 160
AGI monitoring wells and grid squares	6 - 10	10	Polypropylene	Total lead	EPA 7421- AA graphite furnace
				% Moisture	EPA 160
D&M drywell samples	1 - 5 (assumed)	4	Unknown	Total lead (dry weight)	Unknown
D&M drywell samples	5 - 10 (assumed)	4	Unknown	Total lead	Unknown

TABLE 1: ANALYTIC SCHEDULE: SOILS
(Continued)

Source	Sample Depth (Feet)	Number of Samples	Sample Container	Analysis	Analytic Method
D&M dry well sample	10 (assumed)	1	Unknown	Total lead (dry weight)	Unknown
D&M downspout sample	Unknown	1	Unknown	Total lead (dry weight)	Unknown
		103 Total			
Duplicate	0 - 1	2	Polypropylene	Total lead	EPA 7421-AA graphite furnace
				% Moisture	EPA 160
Duplicate	1 - 3	1	Polypropylene	Total lead	EPA 7421-AA graphite furnace
				% Moisture	EPA 160
Rinsate	--	3	Glass	Total lead	EPA 7421
		6 Total QC Samples for 60 AGI Soil Samples, No QC data for 43 D&M Samples			

NOTES:

AGI - Applied Geotechnology Inc.
D&M - Dames & Moore
Source locations shown on Plates 3 to 8
A listing of all samples is provided on Table 2: Soil Sample Summary

Applied Geotechnology Inc.

TABLE 2: SOIL SAMPLE SUMMARY

Sample Number	Location[1]	Ground Surface[2] Elevation (feet)	Sample[3] Depth (feet)	Date Collected	Chemical[4] Analyses	Comments[5]
	Samples Collected From AGI Monitoring Wells					
AGI-1 (1 - 3')	AGI-1	26.3	1 - 3	7/15/86	Pb, %M	
AGI-1 (3 - 6')	AGI-1	26.3	3 - 6	7/15/86	Pb, %M	
AGI-1 (6 -10')	AGI-1	26.3	6 -10	7/15/86	Pb, %M	
AGI-2 (1 - 3')	AGI-2	25.0	1 - 3	7/16/86	Pb, %M	
AGI-2 (3 - 4.5')	AGI-2	25.0	3 - 4.5	7/16/86	Pb, %M	
AGI-2 (6 -10')	AGI-2	25.0	6 -10	7/16/86	Pb, %M	
AGI-3 (1 - 3')	AGI-3	25.1	1 - 3	7/17/86	Pb, %M	
AGI-3 (3 - 6')	AGI-3	25.1	3 - 6	7/17/86	Pb, %M	
AGI-3 (6 -10.5')	AGI-3	25.1	6 -10.5	7/17/86	Pb, %M	
AGI-4 (1 - 3')	AGI-4	25.2	1 - 3	7/18/86	Pb, %M	
AGI-4 (3 - 6')	AGI-4	25.2	3 - 6	7/18/86	Pb, %M	
AGI-4 (6 -10.5')	AGI-4	25.2	6 -10.5	7/18/86	Pb, %M	
	AGI Samples Collected From Grid Squares					
A5 (0 - 1')	A5	26	0 - 1	7/23/86	Pb, %M	
A5 (1 - 3')	A5	26	1 - 3	7/23/86	Pb, %M	
B5 (0 - 1')	B5	26	0 - 1	7/23/86	Pb, %M	
B6 (1 - 3')	B6	26	1 - 3	7/23/86	Pb, %M	
C2 (1 - 3')	C2	25	1 - 3	7/22/86	Pb, %M	C2 in cleanup area
C2 (3 - 6')	C2	25	3 - 6	7/22/86	Pb, %M	
C2 (6 -10')	C2	25	6 - 10	7/22/86	Pb, %M	
C3 (1 - 3')	C3	25	1 - 3	7/22/86	Pb, %M	C3 in cleanup area
C3 (3 - 6')	C3	25	3 - 6	7/22/86	Pb, %M	
C3 (6 -10')	C3	25	6 - 10	7/22/86	Pb, %M	
C5 (0 - 1')	C5	26	0 - 1	7/23/86	Pb, %M	
C5 (1 - 3')	C5	26	1 - 3	7/23/86	Pb, %M	
C5 (3 - 6')	C5	26	3 - 6	7/23/86	Pb, %M	
C5 (6 - 10')	C5	26	6 - 10	7/23/86	Pb, %M	

Applied Geotechnology Inc.

TABLE 2: SOIL SAMPLE SUMMARY
(Continued)

Sample Number	Location[1]	Ground Surface[2] Elevation (feet)	Sample[3] Depth (feet)	Date Collected	Chemical[4] Analyses	Comments[5]
D1 (0 - 1')	D1	26	0 - 1	7/16/86	Pb, %M	
D1 (1 - 3')	D1	26	1 - 3	7/22/86	Pb, %M	
D1 (3 - 6')	D1	26	3 - 6	7/22/86	Pb, %M	
D1 (6 - 10')	D1	26	6 - 10	7/22/86	Pb, %M	
D2 (0 - 1')	D2	26	0 - 1	7/22/86	Pb, %M	
D2 (1 - 3')	D2	26	1 - 3	7/22/86	Pb, %M	
D2 (3 - 6')	D2	26	3 - 6	7/22/86	Pb, %M	
D2 (6 - 10')	D2	26	6 - 10	7/22/86	Pb, %M	
D3 (0 - 1')	D3	26	0 - 1	7/18/86	Pb, %M	
D4 (0 - 1')	D4	26	0 - 1	7/22/86	Pb, %M	
D4 (1 - 3')	D4	26	1 - 3	7/22/86	Pb, %M	
D4 (3 - 6')	D4	26	3 - 6	7/22/86	Pb, %M	
D4 (6 - 10')	D4	26	6 - 10	7/22/86	Pb, %M	Rinsate sample obtained
D5 (0 - 1')	D5	26	0 - 1	7/23/86	Pb, %M	
D6 (1 - 3')	D6	26	1 - 3	7/23/86	Pb, %M	Rinsate sample obtained
E1 (1 - 3')	E1	25	1 - 3	7/23/86	Pb, %M	E1 in cleanup area
E6 (1 - 3')	E1	25	1 - 3	7/23/86	Pb, %M	Duplicate of E1 (1 - 3')
E1 (3 - 6')	E1	25	3 - 6	7/23/86	Pb, %M	
E2 (0 - 1')	E2	26	0 - 1	7/23/86	Pb, %M	
E3 (0 - 1')	E3	26	0 - 1	7/23/86	Pb, %M	
E3 (1 - 3')	E3	26	1 - 3	7/23/86	Pb, %M	
E3 (3 - 6')	E3	26	3 - 6	7/23/86	Pb, %M	
E4 (0 - 1')	E4	26	0 - 1	7/17/86	Pb, %M	
D9 (0 - 1')	E4	26	0 - 1	7/17/86	Pb, %M	Duplicate of E4 (0 - 1')
E5 (0 - 1')	E5	26	0 - 1	7/23/86	Pb, %M	
E5 (1 - 3')	E5	26	1 - 3	7/23/86	Pb, %M	
E5 (3 - 6')	E5	26	3 - 6	7/23/86	Pb, %M	

TABLE 2: SOIL SAMPLE SUMMARY
(Continued)

Sample Number	Location[1)]	Ground Surface[2)] Elevation (feet)	Sample[3)] Depth (feet)	Date Collected	Chemical[4)] Analyses	Comments[5)]
F1 (0 - 1')	F1	26	0 - 1	7/15/86	Pb, %M	
F2 (0 - 1')	F2	26	0 - 1	7/15/86	Pb, %M	
F2 (1 - 3')	F2	26	1 - 3	7/23/86	Pb, %M	
F3 (0 - 1')	F3	26	0 - 1	7/16/86	Pb, %M	
FB (0 - 1')	F3	26	0 - 1	7/16/86	Pb, %M	Duplicate of F3 (0 - 1')
F4 (0 - 1')	F4	26	0 - 1	7/23/86	Pb, %M	
F4 (1 - 3')	F4	26	1 - 3	7/23/86	Pb, %M	
	AGI Resampling of Dames & Moore Background Samples					
DM1 (0 - 1')	BG-1	26	0 - 1	7/16/86	Pb, %M	
DM5 (0 - 1')	BG-5	25	0 - 1	7/16/86	Pb, %M	
DM9 (0 - 1')	BG-9	27	0 - 1	7/16/86	Pb, %M	
	Dames & Moore 7/2/86 Background Samples					
BG-1	BG-1	26	0 - .5	7/2/85	Pb	Sample depths for all BG samples are assumed to be 0 - .5'
BG-2	BG-2	26	0 - .5	7/2/85	Pb	
BG-3	BG-3	25	0 - .5	7/2/85	Pb	
BG-4	BG-4	25	0 - .5	7/2/85	Pb	
BG-5	BG-5	25	0 - .5	7/2/85	Pb	
BG-6	BG-6	25	0 - .5	7/2/85	Pb	
BG-7	BG-7	26	0 - .5	7/2/85	Pb	
BG-8	BG-8	26	0 - .5	7/2/85	Pb	
BG-9	BG-9	27	0 - .5	7/2/85	Pb	
BG-10	BG-10	27	0 - .5	7/2/85	Pb	

TABLE 2: SOIL SAMPLE SUMMARY
(Continued)

Applied Geotechnology Inc.

Sample Number	Location[1)]	Ground Surface[2)] Elevation (feet)	Sample[3)] Depth (feet)	Date Collected	Chemical[4)] Analyses	Comments[5)]
	Dames & Moore 7/29/85 Background Samples					
BR-1	BR-1		0 - .5	7/29/85	Pb	Sample depths for all BR
BR-2	BR-2		0 - .5	7/29/85	Pb	samples assumed to be
BR-3	BR-3		0 - .5	7/29/85	Pb	0 - .5'
BR-4	BR-4		0 - .5	7/29/85	Pb	
BR-5	BR-5		0 - .5	7/29/85	Pb	
BR-6	BR-6		0 - .5	7/29/85	Pb	
BR-7	BR-7		0 - .5	7/29/85	Pb	
BR-8	BR-8		0 - .5	7/29/85	Pb	
BR-9	BR-9		0 - .5	7/29/85	Pb	
BR-10	BR-10		0 - .5	7/29/85	Pb	
	Dames & Moore 7/25/85 Drywell Samples					
W-1	Drywell	26	1 - 5	7/25/85	Pb	Sample depths assumed
W-2	Drywell	26	5 - 10	7/25/85	Pb	based on September 6,
N-1	Drywell	26	1 - 5	7/25/85	Pb	1985 Dames & Moore
N-2	Drywell	26	5 - 10	7/25/85	Pb	report
E-1	Drywell	26	1 - 5	7/25/85	Pb	
E-2	Drywell	26	5 - 10	7/25/85	Pb	
S-1	Drywell	26	1 - 5	7/25/85	Pb	
S-2	Drywell	26	5 - 10	7/25/85	Pb	
DW-B	Drywell	26	10	7/25/85	Pb	
SDS	Downspout	26	0 - .5	7/25/85	Pb	Sample SDS is composite from 9 locations around downspout on south side of Building 5

TABLE 2: SOIL SAMPLE SUMMARY
(Continued)

Applied Geotechnology Inc.

Sample Number	Location 1)	Ground Surface 2) Elevation (feet)	Sample 3) Depth (feet)	Date Collected	Chemical 4) Analyses	Comments 5)
	Dames & Moore 7/29/85 Samples Taken After Cleanup					
1	1 - C4	25	1 - 2	7/29/85	Pb	Sample depth assumed for all 1 through 10 samples
2NW	2NW-C2	25	1 - 2	7/29/85	Pb	
2NE	2NE-C3	25	1 - 2	7/29/85	Pb	
2SW	2SW-C2	25	1 - 2	7/29/85	Pb	All samples are composite from sample area. Number of locations composited is unknown
2SE	2SE-C3	25	1 - 2	7/29/85	Pb	
3	3 - C1	25	1 - 2	7/29/85	Pb	
4	4 - E1	25	1 - 2	7/29/85	Pb	
5	5 - C4	25	1 - 2	7/29/85	Pb	
6	6 - C1	25	1 - 2	7/29/85	Pb	
7	7 - C2	24	1 - 2	7/29/85	Pb	
8	8 - C1	25	1 - 2	7/29/85	Pb	
9	9 - D4	26	1 - 2	7/29/85	Pb	
10	10- D5	26	1 - 2	7/29/86	Pb	

NOTES:

1. - Monitoring well locations shown on Plate 9.
   - AGI grid square layout and sampling locations shown on Plates 3, 6, 7, and 8. 0 to 1 foot samples are composite of one sample from each quadrant (i.e. composite of 4 locations). Samples from below 1 foot are composited from 2 locations in each grid square.
   - Location of AGI resampling of BG samples shown on Plate 4.
   - Location of D&M samples shown on Plates 4 through 8. The D&M drywell samples were collected from the north, south, east, and west sides of the dry well excavation and are designated N, S, E, W, respectively.

2. Ground surface elevations visually estimated based on elevation survey and stick-up measurements of groundwater monitoring wells. Elevation datum arbitrarily set at +30.00 on top of fire hydrant near Well CT4.

3. Sample depths which show a range (e.g. 1 - 3') are composites from that depth range, except the Dames & Moore drywell samples; these are grab samples from some depth within the specified range.

4. Pb = Total lead, dry weight basis
   %M = Percent moisture

5. Rinsate samples obtained by passing distilled water through sampler and capturing the water in a sample container.

Groundwater Monitoring

Four groundwater monitoring wells labeled AGI-1 through AGI-4 were installed in July, 1986 at the locations shown on Plate 9. The wells were installed with a cable tool drill rig and composite soil samples were obtained during drilling from the depth ranges described earlier. Installation diagrams for the wells, along with a Well Installation Legend, are presented in Appendix B.

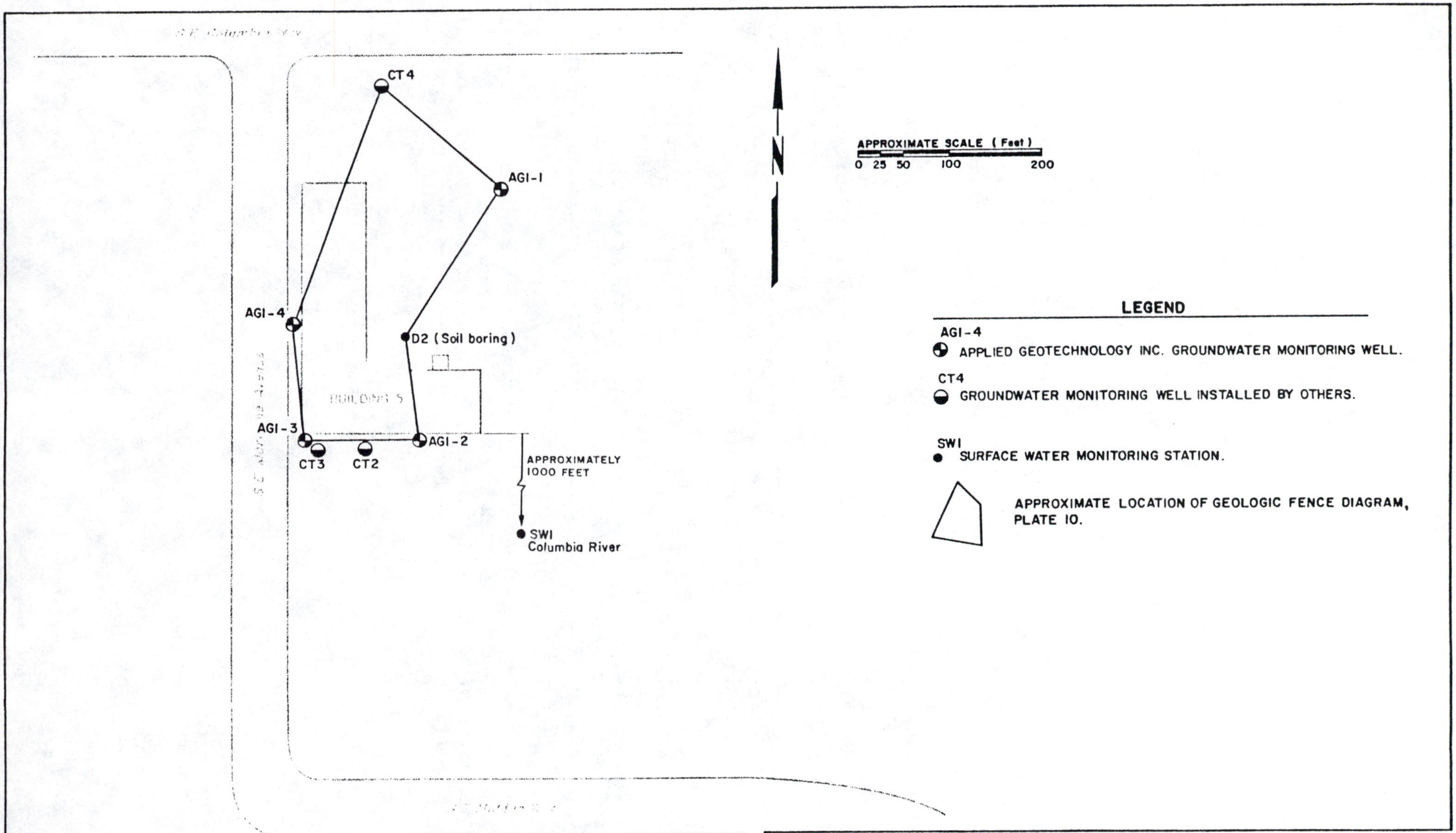
After installation, each well was developed and sampled. Four replicate samples were obtained from the upgradient well (AGI-1) and one sample each from the downgradient wells, for a total of seven samples. Temperature, conductivity, and pH were measured in the field for each sample. Samples were then sent to Analytical Technologies Inc. and analyzed for dissolved cadmium and lead. The analytical schedule and a sampling summary is presented in Table 3.

Three other groundwater monitoring wells (CT2, CT3, and CT4) were previously installed by Sweet Edwards & Associates (SE) at the locations shown on Plate 9. CT3 and CT4 were sampled once by SE immediately after installation and CT4 was later sampled by Dames & Moore. Table 3 summarizes the CT well analyses.

One surface water station, SW1, consisting of a staff gage, was also installed in the Columbia River as part of this investigation. The staff gage was installed to monitor water level changes in the river relative to groundwater elevations.

Following well installation and development, all AGI and CT wells and station SW-1 were surveyed to a common vertical datum. The datum was assumed as +30.00 feet on top of a fire hydrant located near CT4. Measuring point elevations were set at top-of-PVC casing for all wells and at the top of the staff gage for SW-1. Table 4 summarizes elevation and depth data for all wells and SW-1.

Groundwater and Columbia River elevations were monitored on July 18, 23, and 24, to determine flow directions in site aquifers and to evaluate Columbia River tidal fluctuation on groundwater flow. Water elevation data is summarized in Table 5, in Section 2.2, Hydrology.



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

MONITORING WELL LOCATIONS

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE 9

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	1-8-86		

TABLE 3: ANALYTIC SCHEDULE/SAMPLING SUMMARY: GROUNDWATER

Applied Geotechnology Inc.

Well Number [1]	Hydrostratigraphic Unit [2]	Sample Number	Date Collected	Collected By [3]	Analyses [4]	EPA Analytic Method	Comments
AGI-1	Sand Aquifer	AGI-1A	7/19/86	AGI	Lead, Cadmium	7421, 7131	AGI-1A through 1D are replicates
		AGI-1B	7/19/86	AGI	Lead, Cadmium	7421, 7131	
		AGI-1C	7/19/86	AGI	Lead, Cadmium	7421, 7131	
		AGI-1D	7/19/86	AGI	Lead, Cadmium	7421, 7131	
AGI-2	Sand Aquifer	AGI-2	7/19/86	AGI	Lead, Cadmium	7421, 7131	
AGI-3	Sand Aquifer	AGI-3	7/19/86	AGI	Lead, Cadmium	7421, 7131	
		AGI-5	7/19/86	AGI	Lead, Cadmium	7421, 7131	Blind duplicate of AGI-3 Rinsate sample collected [5]
AGI-4	Sand Aquifer	AGI-4	7/19/86	AGI	Lead, Cadmium	7421, 7131	
CT4	Fill Aquifer?	Well CT-1 [6]	4/86	D&M	Lead, Cadmium, other metals	Unknown	
			1/86	D&M	Lead, Cadmium, other metals	Unknown	
			11/85	D&M	Lead, Cadmium, other metals	Unknown	
CT4	Fill Aquifer?	CT-4	2/28/85	SE	Lead	Unknown	
CT3	Fill Aquifer	CT-3	2/28/85	SE	Lead	Unknown	

NOTES:

1) See Plate 9, Monitoring Well Locations, for source locations.
2) This column lists the aquifer (hydrostratigraphic unit) in which each well is screened. Refer to the text and to Plate 10, Geologic Fence Diagram, for a description of site hydrostratigraphic units.
3) AGI - Applied Geotechnology Inc.
   D&M - Dames & Moore
   SE - Sweet Edwards & Associates
4) All analyses for total dissolved concentrations. Conductivity, pH, and temperature measured in the field for all AGI samples. Conductivity and pH apparently measured in laboratory for D&M samples.
5) Rinsate sample obtained by passing distilled water through decontaminated bailer after collecting indicated sample.

TABLE 4: MONITORING WELL AND SURFACE WATER STATION ELEVATIONS [1)]

Well or Surface Water Station [2)]	Measuring Point Elevation (Feet) [3)]	Land Surface Elevation (Feet)	Boring Depth (Feet)	Screen Depth (Feet)	Hydrostratigraphic Unit Screened [4)]
AGI-1	25.33	26.3	34.5	28 - 33	Sand Aquifer
AGI-2	25.38	25.0	33.5	27 - 32	Sand Aquifer
AGI-3	24.80	25.1	34.0	27.5-32.5	Sand Aquifer
AGI-4	26.06	25.2	34.5	28 - 33	Sand Aquifer
CT2	26.14	25	10.5	5 - 10	Fill Aquifer
CT3	25.88	25	10.0	5 - 10	Fill Aquifer
CT4	27.22	26	24.0	19 - 24	Fill Aquifer?
SW-1	0.31	--	--	--	Columbia River

NOTES:

1) Elevation is based on arbitrary datum established as +30.00 feet on top of fire hydrant near CT4.
2) See Plate 9 for locations.
3) Measuring point is top of PVC for all wells and top of staff gage for SW-1.
4) Refer to text and Plate 10 for description of hydrostratigraphic units.

2.0 SITE CONDITIONS

2.1 Land Surface

Building 5 is primarily a steel sided warehouse with a concrete slab-on-grade floor and perimeter footings. A small office at the north end of the building is constructed of masonry block.

Building 5 is located within the Columbia Industrial Park (CIP) which extends approximately 750 feet to the west and over a mile to the east, and is bordered to the north and south by Burlington Northern Railroad tracks and the Columbia River, respectively (see Plates 1 and 5). The CIP property has been used for industrial purposes since at least World War II, when it supported a major ship building operation. There are currently a number of steel manufacturing operations within CIP, along with other light manufacturing facilities.

Most of the CIP land surface is relatively flat and covered with asphalt pavement or buildings. A steep, approximately 25-foot high bank slopes down to the Columbia River. The BN railroad tracks are supported on an approximately 15-foot high fill embankment.

The CIP property is criss-crossed with numerous buried utility lines. Many of the lines are abandoned. Line locations were only established for this investigation to clear boring locations before drilling.

The area immediately around Building 5 is similar to the rest of CIP. A paved road, S.E. Maritime Avenue, extends along the west side of Building 5 and a paved parking lot borders the north side of Building 5. The road was widened and repaved in July, 1986. The south side of Building 5, unlike the other areas, is unpaved and covered with a sparse growth of weeds.

The waste disposal area on the east side of the building is also paved, except where it was excavated during the 1985 cleanup. However, much of the asphalt is badly decomposed and the asphalt surface is rough and broken. In some places, the asphalt appears to have completely disintegrated and has merged with the underlying sandy gravel base course. Decomposed asphalt is restricted to the area west of an existing railroad track. The track extends directly north along the east side of Building 5 and then curves to the west, as shown on Plate 2, Site Features. East and north of the tracks, the pavement is in excellent condition, indicating it is considerably younger than the pavement west of the tracks.

Results of the 1985 cleanup are evident as shallow excavations near the edge of Building 5. An outline of the excavated areas is shown on Plate 2. Approximately 12 inches of soil, including the surface asphalt, was removed from most of the cleanup area. In two areas, additional soil was removed. One is a 36-inch deep excavation shown on Plate 2 and the other is the drywell excavation. As described previously, soil was excavated to a depth of 10 feet around the drywell after the well had been removed. The excavation width is not known precisely, but was reportedly 15 feet. The sides of the excavation have slumped since 1985 and have undermined the adjacent building foundation. The drywell excavation is currently about 6 feet deep and 20 by 20 feet in width.

2.2 Geology

Our interpretation of geologic conditions at the site is shown on Plate 10, Geologic Fence Diagram. The Fence Diagram location is shown in plan view on Plate 9. Our interpretation is based on the borings shown, as well as logs of CT2 and CT3 located between AGI-2 and AGI-3, and of the numerous soil borings in the area around D2. Logs of these borings are in Appendix B.

Hydraulic Fill

The youngest deposit at the site consists of "recent" Fill placed at the land surface. The uppermost part of the Fill is a sand and gravel base course placed for support of the overlying asphalt pavement. The base course varies between 6 and 18 inches in thickness and averages about 12 inches. The sand and gravel base course is not shown on the Fence Diagram for purposes of clarity.

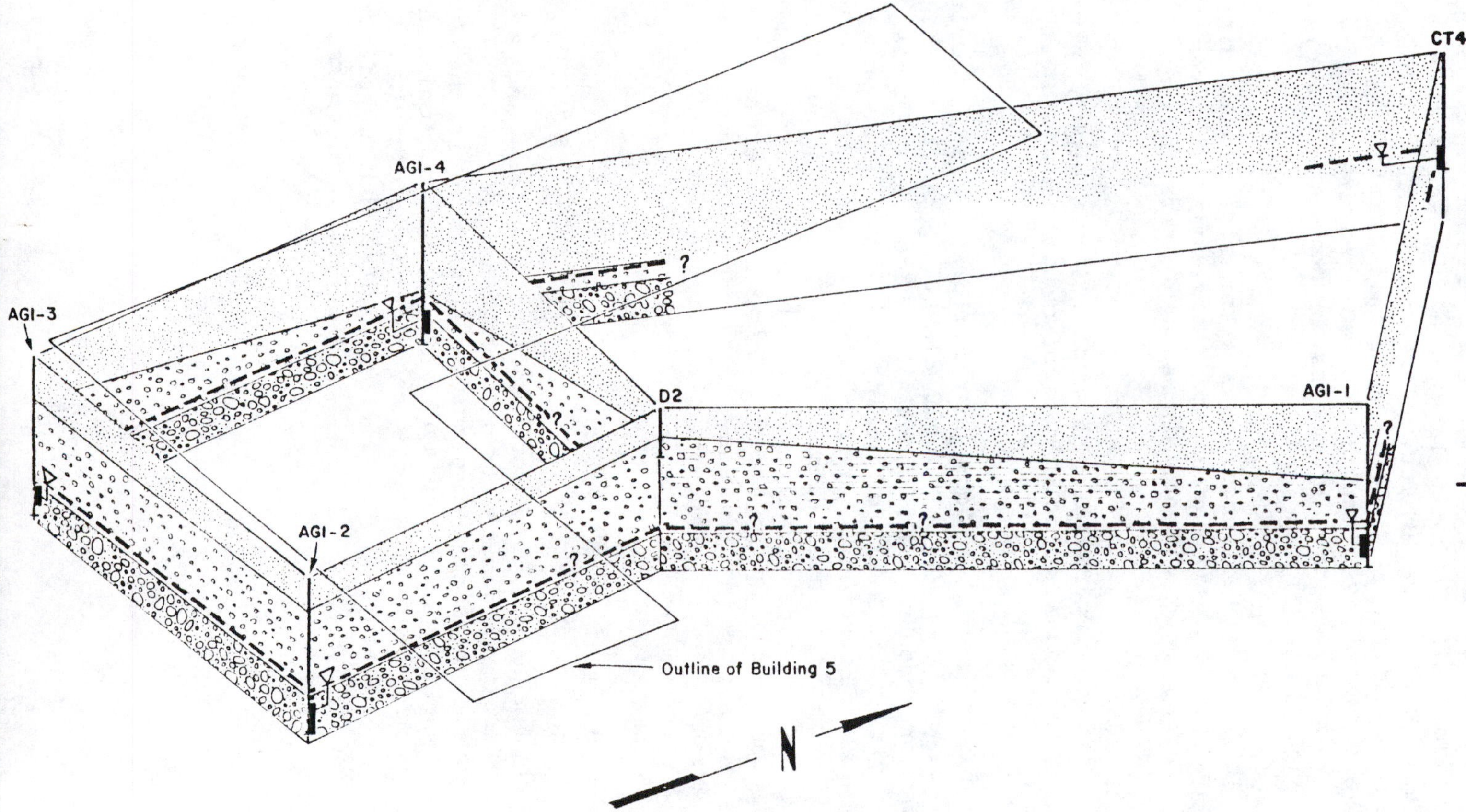
Below the base course and extending to depths of between 6 and 24 feet, or greater, below land surface is a horizontally bedded medium-grained sand or pebbly sand. This sand appears to be a Hydraulic Fill derived from dredging the Columbia River. The Fill was probably used to raise the area above flood levels.

The Hydraulic Fill is fairly consistently 6 to 7 feet thick in the waste disposal area and along the south side of Building 5, but thickens rapidly to the north and west. The most likely interpretation of this data is that a low-lying channel or basin existed to the north and west of Building 5 prior to filling.

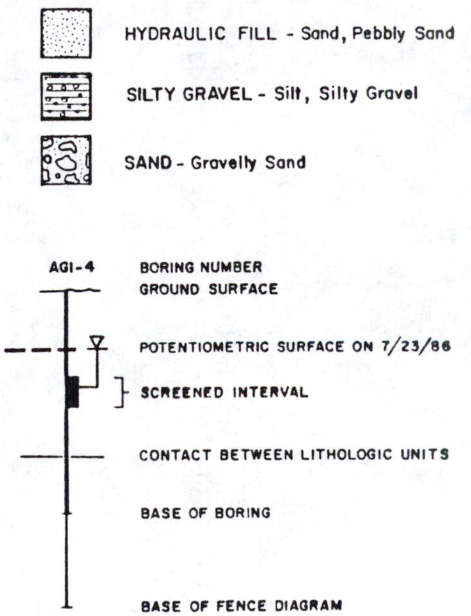
Silty Gravel

Underlying the Hydraulic Fill are native deposits of silt, sandy silt, and gravelly silt or silty gravel ("Silty Gravel"). The Silty Gravel thickness varies considerably from approximately 23 feet at AGI-2 to 3 feet at AGI-4. This variation in thickness is due almost entirely to relief on the upper surface of the Silty Gravel, as there is virtually no change in the base elevation. The base is at about Elevation -2 or -3 feet.

The uppermost 1 to 5 feet of the Silty Gravel generally consists of dark brown silt and sand or silt with a small amount of gravel. With depth, the percentage of silt generally decreases and the percentage of gravel increases, such that the deposit grades downward into gravelly silt, then into silty gravel, and finally into sandy gravel with some silt. The gravel consists predominantly of rounded to very angular black basalt fragments, probably deposited as channel or flood plain gravels associated with the Columbia River.



LEGEND

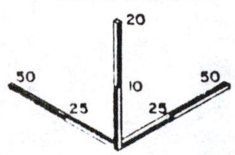


NOTE:
TOP OF FENCE SET AT ELEVATION + 26.0 FEET. ACTUAL SURFACE ELEVATIONS RANGE FROM 25 TO 27 FEET. BASE OF FENCE SET AT ELEVATION - 9.0 FEET.

NOTE:

Geologic Sections are diagramatic interpretations of sub-surface conditions based on interpolation and extrapolation from test borings. Actual sub-surface conditions are substantially more complex than depicted and will vary between borings.

SCALE (Feet)



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

GEOLOGIC FENCE DIAGRAM

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **10**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15.103.001	LDS	MAA	10-8-86		

Sand

The sandy gravel at the base of the Silty Gravel grades downward into a water bearing gravelly sand. This lower deposit, labeled Sand, is very similar to the base of the Silty Gravel Aquitard except it contains virtually no silt and contains a greater proportion of sand.

2.3 Hydrology

Surface Water

There are no well defined surface water runoff patterns around Building 5 due to the lack of relief and the lack of a drainage system. During periods of rainfall, surface water accumulates as puddles on the land surface and eventually infiltrates the ground. Infiltration is generally slow because most areas are paved and those not paved are covered with densely packed soil. Flooding reportedly occurs in some areas during periods of heavy or prolonged rainfall.

Infiltration in the waste disposal area (east side of Building 5) is more rapid then surrounding areas because of the decomposed pavement. However, even in this area, water stands in some depressions for several days following a rainfall.

The excavated areas near Building 5 expose loose highly permeable sands which allow rapid infiltration. No surface water would stand in these areas.

The only major surface water body near Building 5 is the Columbia River. In July, the river level was at about Elevation -4 (based on assumed +30 datum) which corresponds with about Elevation +2 Columbia River Datum (CRD). River elevations measured during this investigation are summarized on Table 5, Water Elevations. According to the U.S. Army Corps of Engineers, the river rises to near Elevation +16 CRD during the late winter and spring, and falls to near Elevation 0 CRD during the later summer and fall. Tidal fluctuations range up to 4 feet during low water periods and may be negligible during high water periods. Data supplied by the U.S. Army Corps of Engineers from the I-5 bridge gaging station showed river elevations fluctuating between +1 and +5 feet CRD during July 1986 (-5 to -1 feet relative to +30 datum).

Groundwater

An upper perched aquifer, a lower confined aquifer, and an intervening aquitard were identified during our field investigation. The upper aquifer labeled Fill Aquifer consists of groundwater perched in the Hydraulic Fill on top of the underlying Silty Gravel ("Silty Gravel Aquitard"). A lower aquifer labeled Sand Aquifer occurs beneath the Silty Gravel Aquitard in the Sand deposit described previously. The distribution of these units is shown on the Fence Diagram, Plate 10. Following is a description of each hydrologic unit.

TABLE 5: WATER ELEVATIONS

Station	Measuring Point Elevation* (Feet)	Water Elevation (Feet)/Time 7/16/86	7/23/86	7/24/86	7/24/86	7/24/86
SW-1 Columbia River	0.31	--	-4.49/1800	-3.84/0800	-3.79/1231	--
AGI-1	25.33	--	- .03/1755	- .01/0743	.03/1216	.03/1402
AGI-2	25.38	--	- .11/1802	- .13/0745	- .09/1221	- .09/1426
AGI-3	24.80	--	- .14/1809	- .15/0754	- .11/1226	- .11/1428
AGI-4	26.06	--	- .14/1812	- .11/0755	- .09/1229	- .09/1431
CT2	26.14	14.97/0912	14.96/1805	14.97/0747	14.97/1222	--
CT3	25.88	17.83/0915	17.72/1808	17.71/0750	17.71/1224	--
CT4	27.22	5.77/0905	5.71/1752	5.72/0757	5.70/1218	--

* Relative to arbitrary datum of +30.00 established top of fire hydrant located near CT4.

Fill Aquifer:

The Fill likely contains perched groundwater during winter or early spring. Although we only encountered slight seepage in two borings during our July explorations, we expect groundwater will accumulate at the base of the Fill during the winter and spring when rainfall is greatest. Infiltrating surface water should pass rapidly downward through the sandy Fill and become temporarily perched on top of the much less permeable Silty Gravel Aquitard before migrating downward.

In addition to vertical migration through the Silty Gravel Aquitard, we anticipate perched groundwater will flow laterally to the north and west down the sloping Hydraulic Fill/Silty Gravel Aquitard contact (see Plate 10).

As indicated previously, we did not observe perched water in all our exploratory borings. However, water was consistently detected in the three monitoring wells (CT2, CT3, and CT4) completed in or near the base of the Hydraulic Fill. Groundwater depths (elevations) were variable between wells. The depth to water at CT2, for example, was 10 feet below land surface (Elevation 14.97) on July 16, 1986, indicating .5 feet of water in the well. At nearby Well CT3, depth to water on the same date was only about 7 feet (Elevation 17.83) indicating 3 feet of water in the well.

The discrepancy in saturated thickness in the Fill Aquifer, as exemplified by water levels in CT2 and CT3, relates to local recharge conditions and well design methods. Both CT2 and CT3 extend 2.5 feet downward into the Silty Gravel Aquitard and the water levels in both wells are near or below the top of the Aquitard (base of the Fill). This relationship suggests that the two wells are acting as sumps and that water perched on the Silty Gravel Aquitard is draining into and then standing in the wells. Greater recharge at CT3 from a nearby downspout could account for the greater saturated thickness in CT3 relative to CT2.

Groundwater elevations at CT4, located north of Building 5, were considerably deeper than at CT2 and CT3 as the Hydraulic Fill is much thicker at this location. Water levels in CT4 appear to reflect water actually perched in the Fill Aquifer. However, the CT4 boring was not drilled deep enough to confirm the presence of the underlying Silty Gravel Aquitard. If the Silty Gravel Aquitard is missing at CT4, the Fill and Sand Aquifers would be in direct hydraulic connection and the measured water level would reflect Sand Aquifer water elevations.

Silty Gravel Aquitard:

The Silty Gravel deposit is much finer-grained than either the overlying Hydraulic Fill or underlying Sand. As a consequence, it is much less permeable and serves as an aquitard separating the two deposits.

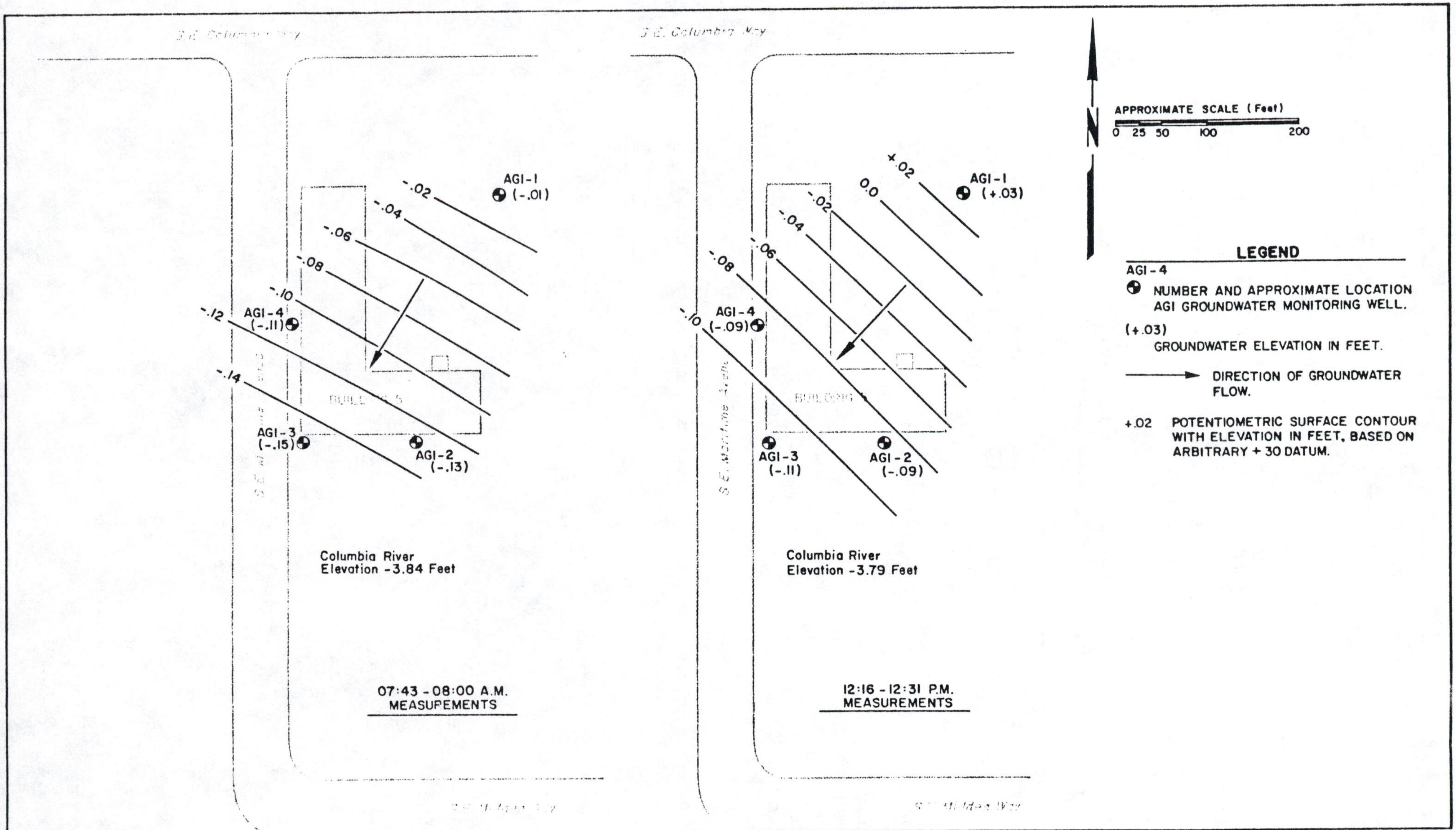
Sand Aquifer:

Groundwater in the Sand Aquifer is partially confined by the overlying Silty Gravel Aquitard. Water elevations measured in the AGI wells (all of which are screened in the Sand Aquifer) were consistently 1 to 2 feet above the top of the Sand Aquifer (or base of Silty Gravel Aquitard). This relationship is illustrated on the Geologic Fence Diagram.

Aquifer thickness is not known as all well borings were terminated within the upper 4 to 7 feet of the Sand Aquifer.

Groundwater in the Sand Aquifer flows southwestward towards the Columbia River as shown on Plate 11. Two flow patterns are shown; one for measurements taken between 7:43 and 8:00 AM, and a second for measurements between 12:16 and 12:31 PM on July 24, 1986. A .05 foot increase in river elevation between the first and second monitoring rounds is reflected by a .04 foot increase in all monitoring wells except AGI-5, which showed a .02 foot increase. This data suggests tidal fluctuations in the river directly effect groundwater elevations beneath the site. However, measurements taken the previous day (7/23/86) showed higher groundwater elevations despite a lower river level (see Table 5).

This conflicting data indicates a complex aquifer response to tidal fluctuations. Existing data is insufficient to define the response. However, the overall flow direction towards the river probably remains constant during most of the year. An interpolation of the Sand Aquifer potentiometric surface from the Building 5 area to the Columbia River is shown on Plate 12. Flow reversal may occur during periods of rapid increase in river level (flood events).

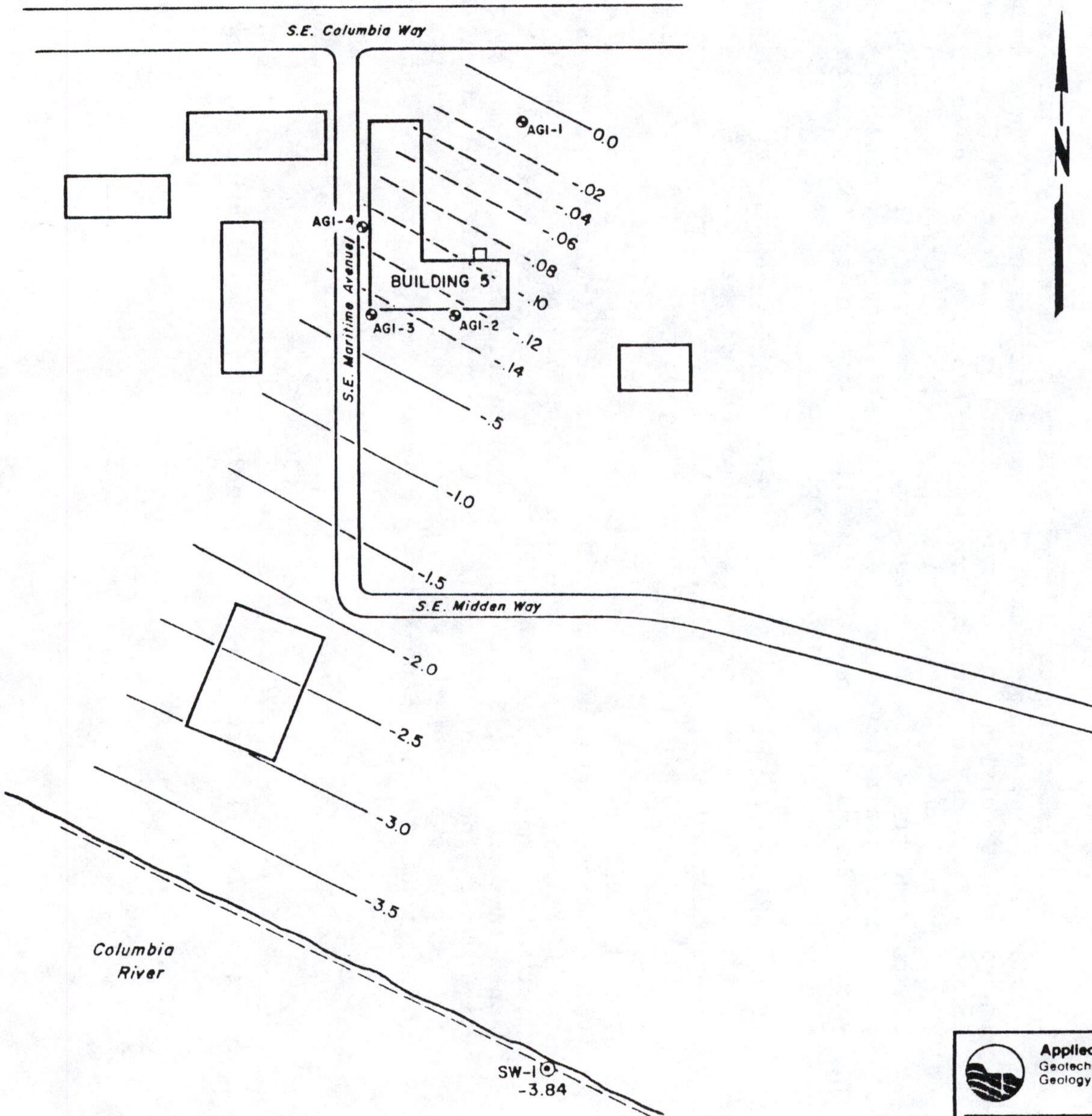


Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

7/24/86 POTENTIOMETRIC SURFACE: SAND AQUIFER
Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **11**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		



APPROXIMATE SCALE (Feet)
0 50 100 200 300 400

LEGEND

- - - - .02 POTENTIOMETRIC SURFACE CONTOURS ON 7/24/86 AS DETERMINED BY EXTRAPOLATION BETWEEN GROUNDWATER MONITORING WELL WATER ELEVATIONS.

——— -1.0 INTERPOLATED POTENTIOMETRIC SURFACE CONTOURS. CONTOURS ILLUSTRATE PROBABLE GENERAL CONFIGURATION OF POTENTIOMETRIC SURFACE.

AGI-4 GROUNDWATER MONITORING WELL.

SW-1 -3.84 SURFACE WATER STATION WITH INDICATED WATER ELEVATION.

-3.84 WATER ELEVATION IN FEET BASED ON ARBITRARY + 30 DATUM.

Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

INTERPOLATED POTENTIOMETRIC SURFACE: SAND AQUIFER
Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **12**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		

3.0 SOIL CHEMISTRY

3.1 Methodology

As described previously, numerous soil samples were collected during this and previous investigations from four depth intervals and analyzed for lead and percent moisture. Laboratory results were reported as total lead on a dry weight basis. The four depth intervals are 0 to 1, 1 to 3, 3 to 6, and 6 to 10 feet. Although the depth intervals were preselected before the field work, they fortunately match the subsurface geology. The 0 to 1 foot samples coincide with asphalt pavement and base course, 1 to 3 and 3 to 6 foot samples with the Hydraulic Fill, and 6 to 10 foot samples with the Silty Gravel. This fortuitous match allows good correlation between lead concentrations and subsurface deposits.

The soil samples were collected from within and outside of the waste disposal area. The purpose of this collection strategy was to use outside samples to define the background distribution of lead. Background values were then statistically compared with lead values in the waste disposal affected area for each depth interval.

There are a number of possible methods to statistically compare two sample populations, i.e. background versus waste disposal area. These methods can generally be divided into two groups; parametric and non-parametric methods. Parametric methods are most often used when the sample populations exhibit the characteristics of a normal distribution ("bell-shaped") or would do so if the number of samples were sufficiently large. Various statistical tests have been devised relative to the normal distribution, which can be used to predict the likelihood of two samples being either from the same or different populations.

If the present population is not normally distributed or if the sample size is small, then non-parametric methods are generally used. These methods are independent of population distribution. That is, no assumptions have to be made about the form of the parent population.

The chemical data from the Building 5 area exhibits a non-normal distribution. Although we have not performed a statistical test to accept or rule out normality, the frequency distribution of most of the sample groups is distinctly non-normal. Consequently, we have chosen the Wilcoxin Rank Sum non-parametric test, in consultation with Dr. Dennis Lettenmaier, Professor of Civil Engineering, University of Washington, as the statistical comparison test. Several of the Wilcoxin test results were double checked by comparing them with the Mann-Whitney U test. Results from the two tests were essentially identical.

Statistical tests are usually interpreted in terms of a significance level, typically 90%, 95%, or 99%, for rejecting a given hypothesis. For this project the hypothesis is "the background samples and the waste disposal area samples are from the same population", i.e. there is no statistical difference between the two groups. The Wilcoxin Rank Sum method tests this hypothesis to see if it can be rejected at a certain significance. The 95% significance level is the conventional choice and has been selected for this project. A 95% significance level means that we are willing to accept only a 5% chance of erroneously claiming the samples come from different populations. Another way of stating this concept is that we want to be so certain the background values and the waste disposal area values are different, that we will only accept a 5% chance of error in claiming that our hypothesis (values are the same) is untrue.

3.2 <u>Surface Soils (0 to 1 foot samples)</u>

Table 6 shows analytic results for surface soil samples and Plates 13, 14, and 15 show the analytic result at each sample location. All AGI samples are composites from the full 0 to 1 foot depth interval. The Dames & Moore BG and BR samples, however, are surface grabs and represent composites to a maximum depth of .5 feet.

Originally, it was intended that all BG and BR samples plus some of the AGI samples would be used for determining background and the remaining AGI samples would define lead concentrations in the waste disposal area. Reviewing the analytic data indicated that dividing the AGI samples into background and waste disposal area would not be possible. Although there is a slight decrease in lead concentrations away from Building 5 (see Plate 13), the pattern is not clear. Consequently, all of the AGI samples have been included within the waste disposal sample group.

Statistical values for the two sample groups are summarized in Table 7, Statistics Summary. As shown, the mean lead concentration in the waste disposal area is considerably higher than background, but the medians are more similar. The reason for the discrepancy between mean and medium in the waste disposal area lies with the one extremely high lead value at A5 (1606 mg/kg). This value is so much higher than the rest of the values that it skews the mean upward. The median is not affected by this high value.

Statistical comparison of the background and waste disposal samples indicates they can not be distinguished at the 95% significance level. That is, the hypothesis that both the waste disposal area and background samples are from the same population can not be rejected.

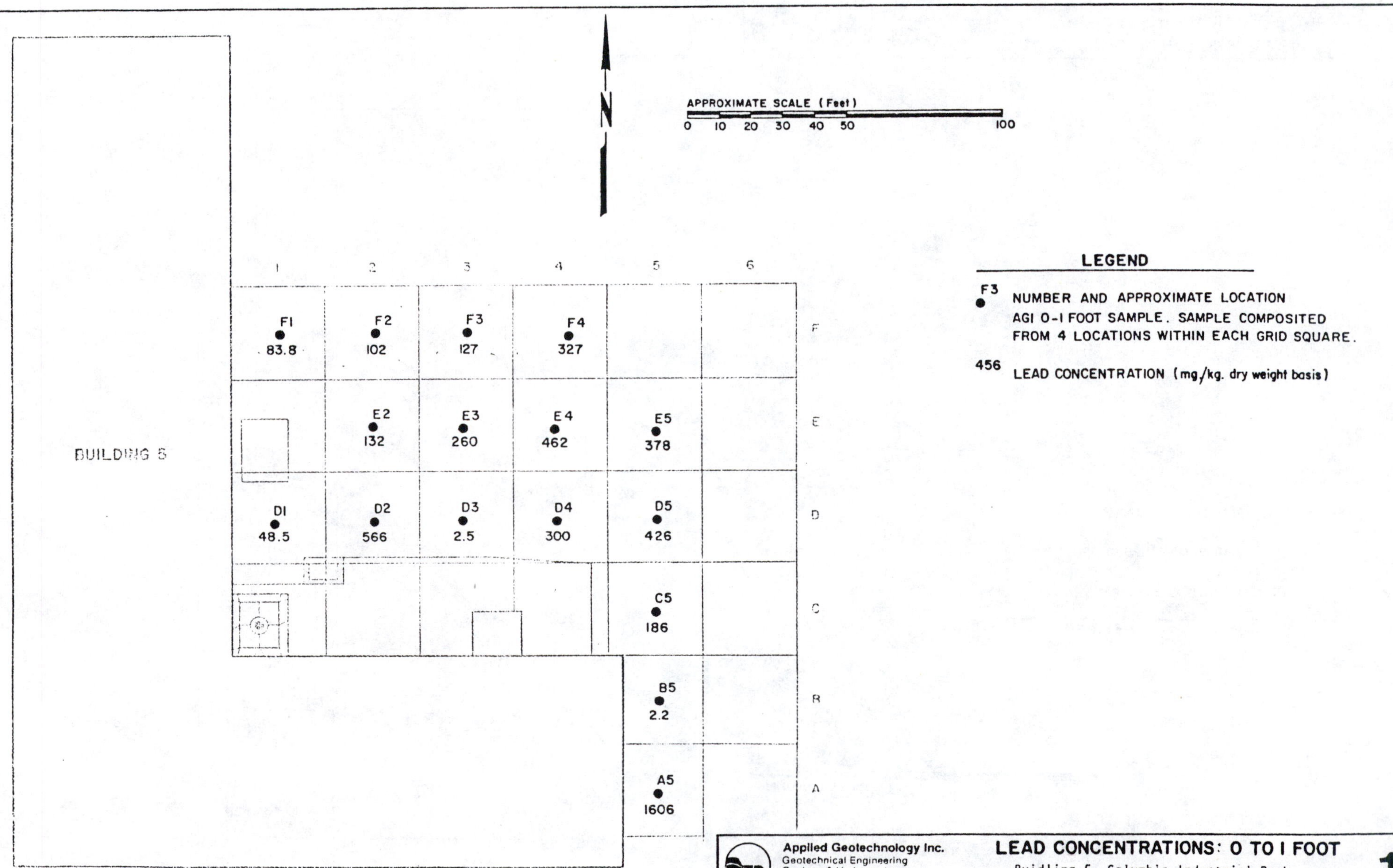
One potential problem with this comparison is non-equivalence between the AGI 0 to 1 foot composites and the Dames & Moore background samples. To test comparability, three AGI samples composited from a full 0 to 1 foot were obtained from three BG sample locations. The three AGI samples, DM1, DM5, and DM9, correspond with BG-1, BG-5, and BG-9, respectively.

As shown in Table 6, the three AGI samples contain considerably less lead than the BG samples.

TABLE 6
ANALYTIC RESULTS: SURFACE SOILS

Sample Number[1]	% Moisture	Total Lead (mg/kg dry weight): Sample	Resample	/Sample[2] /Number	Field Duplicate	/Sample /Number	Laboratory Duplicate	Total Lead in Rinsate (mg/l)
Waste Disposal Area								
A5 (0-1')	5.35	1606						
B5 (0-1')	3.47	2.2						
C5 (0-1')	6.36	186						
D1 (0-1')	9.60	48.5						
D2 (0-1')	4.49	566						
D3 (0-1')	12.3	2.5					2.4	
D4 (0-1')	6.41	300						
D5 (0-1')	38.1	426						
E2 (0-1')	6.81	132						
E3 (0-1')	36.7	260						
E4 (0-1')	8.61	462			549	D9 (0-1')		
E5 (0-1')	7.38	378						
F1 (0-1')	5.57	83.8						
F2 (0-1')	5.37	102						
F3 (0-1')	6.14	127			47.6	F8 (0-1')		
F4 (0-1')	5.81	327						L/0.002 [3]
Background								
BG-1	--	298	94.9	DM1 (0-1')				
BG-2	--	163						
BG-3	--	373						
BG-4	--	284						
BG-5	--	353	22.8	DM5 (0-1')			21.3	
BG-6	--	15.3						
BG-7	--	124						
BG-8	--	20.1						
BG-9	--	19.1	5.7	DM9 (0-1')				
BG-10	--	43.9						
BR-1	--	414						
BR-2	--	708						
BR-3	--	49						
BR-4	--	123						
BR-5	--	116						
BR-6	--	411						
BR-7	--	126						
BR-8	--	64						
BR-9	--	82.5						
BR-10	--	90						

Notes:
1. Sample locations shown on Plates 13, 14, and 15.
2. Samples DM1, DM5, and DM9 were taken at same location as BG-1, BG-5, and BG-9, respectively, respectively, but are composites from 0 to 1 foot rather than the assumed 0 to .5 foot.
3. Rinsate obtained after sampling F4 (0-1'). L/ indicates less than.



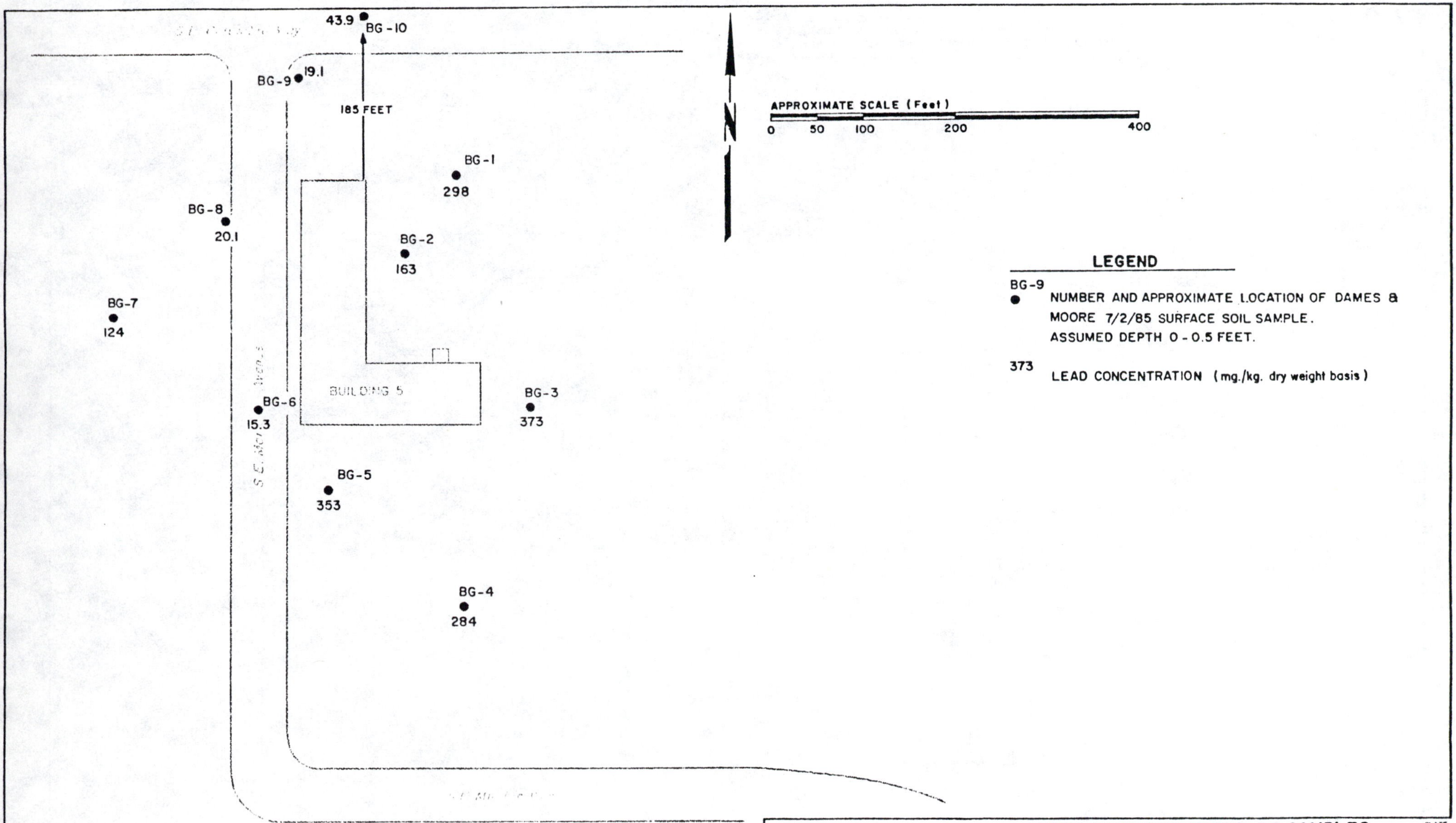
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

LEAD CONCENTRATIONS: 0 TO 1 FOOT

Buidling 5, Columbia Industrial Park
Vancouver, Washington

PLATE **13**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		



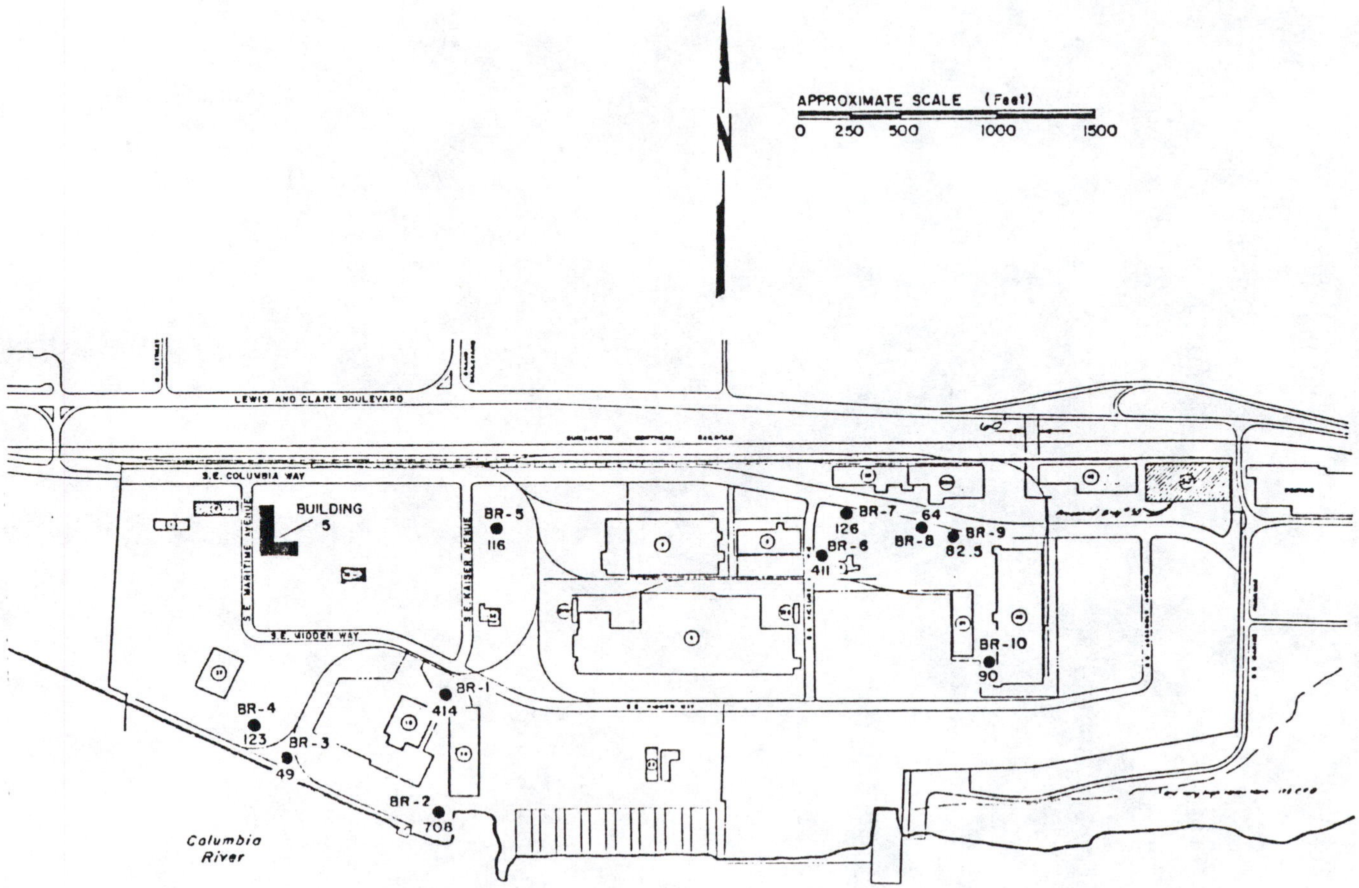
Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

LEAD CONCENTRATIONS: BG SAMPLES

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **14**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		



LEGEND

BR-10 ● NUMBER AND APPROXIMATE LOCATION OF DAMES & MOORE 7/29/85 SURFACE SOIL SAMPLE. ASSUMED DEPTH 0-0.5 FEET.

90 LEAD CONCENTRATION (mg./kg. dry weight basis)

Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

LEAD CONCENTRATION: BR SAMPLES
Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **15**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		

TABLE 7: STATISTICS SUMMARY

	Lead Concentration (mg/kg dry weight)				Wilcoxin Test Statistic	95 Percent Significance Level Statistic
	Range	Mean	Median	Stan. Dev.		
Surface Soils						
Waste disposal area	2.2-1606.	313.1	223	384.9	1.05	1.65
Background	15.3-708.	193.8	124.5	182.7		
1 to 3 Foot Soils						
Waste disposal area	3.0-79.7	20.2	7.6	28.9	.94	1.65
Background	1.8-26.8	8.0	3.5	9.6		
3 to 6 Foot Soils						
Waste disposal area	2.6-34.0	9.7	4.4	10.7	1.54	1.65
Background	1.9-11.5	4.6	2.5	4.6		
6 to 10 Foot Soils						
Waste disposal area	5.0-33.4	17.6	17.5	11.1	1.71	1.65
Background	2.2-15.7	6.9	4.8	6.2		

There are a number of possible explanations for this discrepancy as follows:

- o Lead concentrations reported by either laboratory may be in error.
- o Lead concentrations may actually be substantially higher in the 0 to .5-foot interval than in the 0 to 1-foot interval.
- o Lead concentrations may be highly variable within the surficial soils and the two samples merely reflect this variability.
- o Lead concentrations changed between sampling events.

There is currently insufficient data to determine which of these is the correct explanation. Laboratory quality control checks indicate AGI sample data is accurate and acceptable. Comparable laboratory Q/C data for the Dames & Moore samples has been requested, but is apparently unavailable.

3.3 1 to 3 Foot Soils

Table 8 summarizes analytic results from the 1 to 3 foot interval, and Plate 16 shows sample locations. Samples labeled "other" in Table 8, are not included in the statistical comparisons and are not shown on Plate 16.

The "other" samples were collected by Dames & Moore immediately after the July 1985 cleanup from the base of the cleanup area. The lead concentration detected in these samples was considerably higher than comparable AGI samples. The reason for the discrepancy is not known, but is likely either:

- o Lead concentrations reported by the laboratories are in error.
- o Lead concentrations changed between sampling events.

As with the surface sample, there is insufficient data to determine which explanation applies. However, it is difficult to conceive of a mechanism which would remove the amount of lead necessary to reduce the earlier Dames & Moore values to near those of our later sampling. Because of these difficulties, the Dames & Moore data has been excluded from the statistical comparisons.

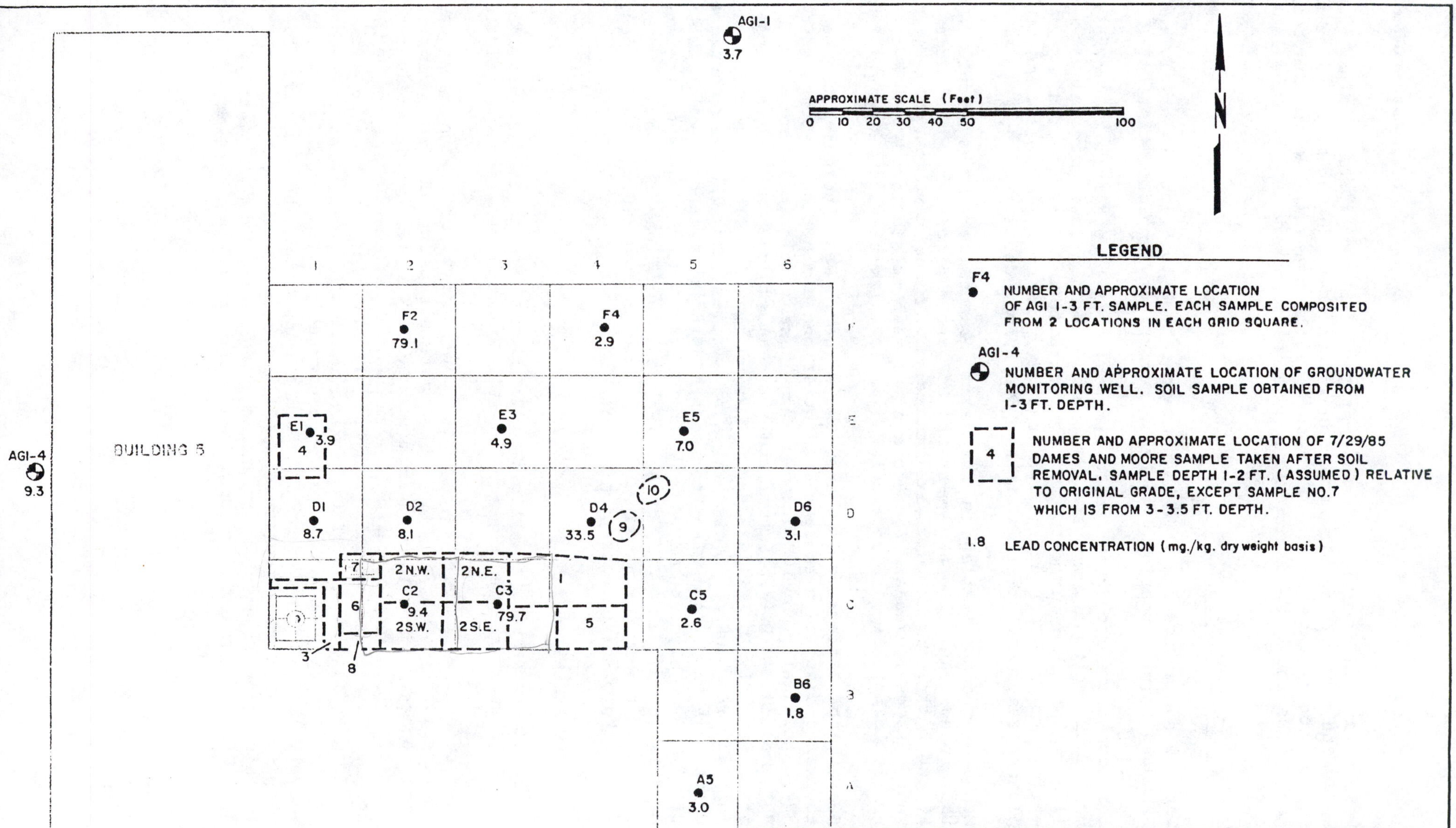
Lead concentrations in the waste disposal area ranged between 2.9 and 79.7 mg/kg. Background concentrations ranged between 1.8 and 26.8 mg/kg. The two highest concentrations 79.7 and 79.1 mg/kg were detected at grid square C3 and F2, respectively. Location C3 is within the July 1985 cleanup area, suggesting that some lead migrated downward prior to cleanup.

The 20.2 mg/kg mean lead concentration in the waste disposal area is higher than the 8.0 mg/kg background mean. If the two 79 mg/kg values are removed, the resulting 8.4 mg/kg mean in the waste disposal area is nearly identical to the background mean.

TABLE 8
ANALYTIC RESULTS: 1-3 FOOT SOILS

Sample Number 1)	% Moisture	Total Lead (mg/kg dry weight basis): Sample	Laboratory Duplicate	Field Duplicate	/ Sample / Number	Total Lead in Rinsate (mg/l)
Waste Disposal Area						
A5 (1-3')	13.3	3.0				
C2 (1-3')	6.49	9.4				
C3 (1-3')	5.91	79.7				
C5 (1-3')	5.66	2.6	2.1			
D1 (1-3')	6.62	8.7				
D2 (1-3')	5.83	8.1				
D4 (1-3')	6.83	33.5				
E1 (1-3')	5.69	3.9	3.3	4.0	E6 (1-3")	
E3 (1-3')	5.49	4.9				
E5 (1-3')	48.1	7.0				
F2 (1-3')	6.38	79.1				
F4 (1-3')	5.26	2.9				
Background						
B6 (1-3')	5.12	1.8				L/0.002 2)
D6 (1-3')	36.8	3.1				
AGI-1 (1-3')	7.01	3.7				
AGI-2 (1-3')	8.66	3.2				
AGI-3 (1-3')	9.35	26.8				
AGI-4 (1-3')	5.79	9.3				
Other						
1	-	2058				
2 NW	-	967				
2 NE	-	2165				
2 SW	-	1876				
2 SE	-	949				
3	-	3904				
4	-	262				
5	-	2794				
6	-	15350				
7	-	1100				
8	-	80				
9	-	294				
10	-	1404				

Notes:
1. Sample locations shown on Plate 16. Samples A5 through F4 and AGI-1 through AGI-4 are composites of the indicated depth range. Samples 1 through 10 are assumed to be grab samples from a 1 to 1.5 foot depth range.
2. Rinsate obtained after sampling D6 (1-3"). L/ indicates less than.



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

LEAD CONCENTRATION: 1 TO 3 FEET

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE 16

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		

Despite the difference in means, statistical comparison of the background and waste disposal sample values show that they can not be distinguished at the 95% confidence level. This essentially means the waste disposal area can not be shown statistically to be more contaminated than the background area.

3.4 3 to 6 Foot Soils

Table 9 summarizes analytic results for the 3 to 6 foot interval, and Plate 17 shows sample locations. Table 7 summarizes sample statistics.

Lead concentration in the waste disposal area ranged from 2.6 mg/kg to 34.0 mg/kg. Background concentrations were slightly lower ranging from 1.9 to 11.5 mg/kg. The highest lead concentrations were detected at C3 (34.0 mg/kg) and E5 (20.8 mg/kg). Note that grid square C3 also contained the highest lead concentration at the 1 to 3 foot depth.

Mean lead concentration in the waste disposal area was about twice the background mean. The two means are 9.7 and 4.6 mg/kg for the waste disposal and background samples, respectively. If the two highest values in the waste disposal area are removed and the mean recalculated, the means become nearly identical. The recalculated waste disposal area mean is 4.7 mg/kg.

Despite the difference in means, the Wilcoxin Test indicates the background and waste disposal area lead concentrations can not be distinguished at the 95% significance level. However, the test statistic is very close to the 95% statistic, and indicates the two populations would be distinguishable at a slightly lower (93%) significance level. If the highest value is removed from the waste disposal area samples, the Wilcoxin test statistic drops to a value equivalent to about a 90% significance level. Subtraction of the next highest value reduces the test statistic even further. This calculation indicates that removing just one area (grid square C3) would result in a waste disposal area with lead concentrations indistinguishable from background concentration at the 95% significance level.

3.5 6 to 10 Foot Soils

Table 10 summarizes analytic results from the 6 to 10 foot interval, and Plate 18 shows sample locations. Table 7 summarizes sample statistics.

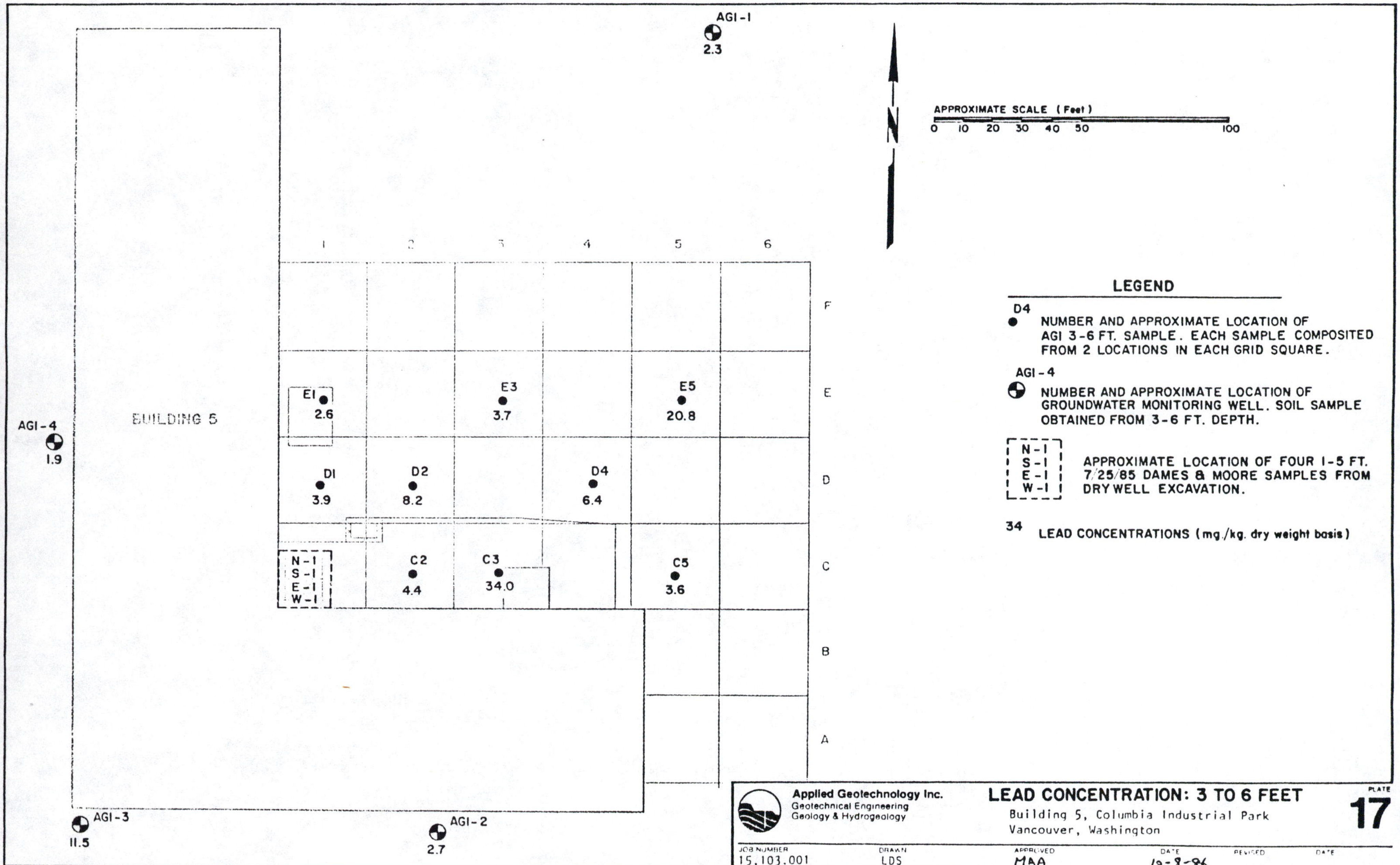
Lead concentrations in the 6 to 10 foot interval are slightly greater than the overlying Hydraulic Fill. The waste disposal area, for example, shows lead concentrations ranging from 5.0 to 33.4 mg/kg, with a mean concentration of 17.6 mg/kg compared to a mean of 9.7 in the overlying 3 to 6 feet soils. Background values are also slightly higher, ranging from 2.2 to 15.7 mg/kg with a mean of 6.9 mg/kg. Most of the increase in lead concentration corresponds to the geologic change from the Hydraulic Fill to Silty Gravel. All of the waste disposal area samples and half the background samples were composited from the Silty Gravel. The Silty Gravel probably contains greater natural concentrations of lead than the overlying Hydraulic Fill sand, and any dissolved lead migrating downward through the

TABLE 9
ANALYTIC RESULTS: 3-6 FOOT SOILS

Sample Number[1]	% Moisture	Total Lead (mg/kg dry weight)
Waste Disposal Area		
C2 (3-6')	7.00	4.4
C3 (3-6')	8.13	34.0
C5 (3-6')	7.33	3.6
D1 (3-6')	6.17	3.9
D2 (3-6')	7.82	8.2
D4 (3-6')	10.6	6.4
E1 (3-6')	7.24	2.6
E3 (3-6')	6.26	3.7
E5 (3-6')	39.7	20.8
Background		
AGI-1 (3-6')	13.6	2.3
AGI-2 (3-4.5')	9.92	2.7
AGI-3 (3-6')	11.0	11.5
AGI-4 (3-6')	12.1	1.9
Drywell Samples		
W1		331
N1		821
S1		272
E1		640

Notes:

1. Sample locations are shown on Plate 17. All samples are composites from indicated depth range.



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

LEAD CONCENTRATION: 3 TO 6 FEET

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **17**

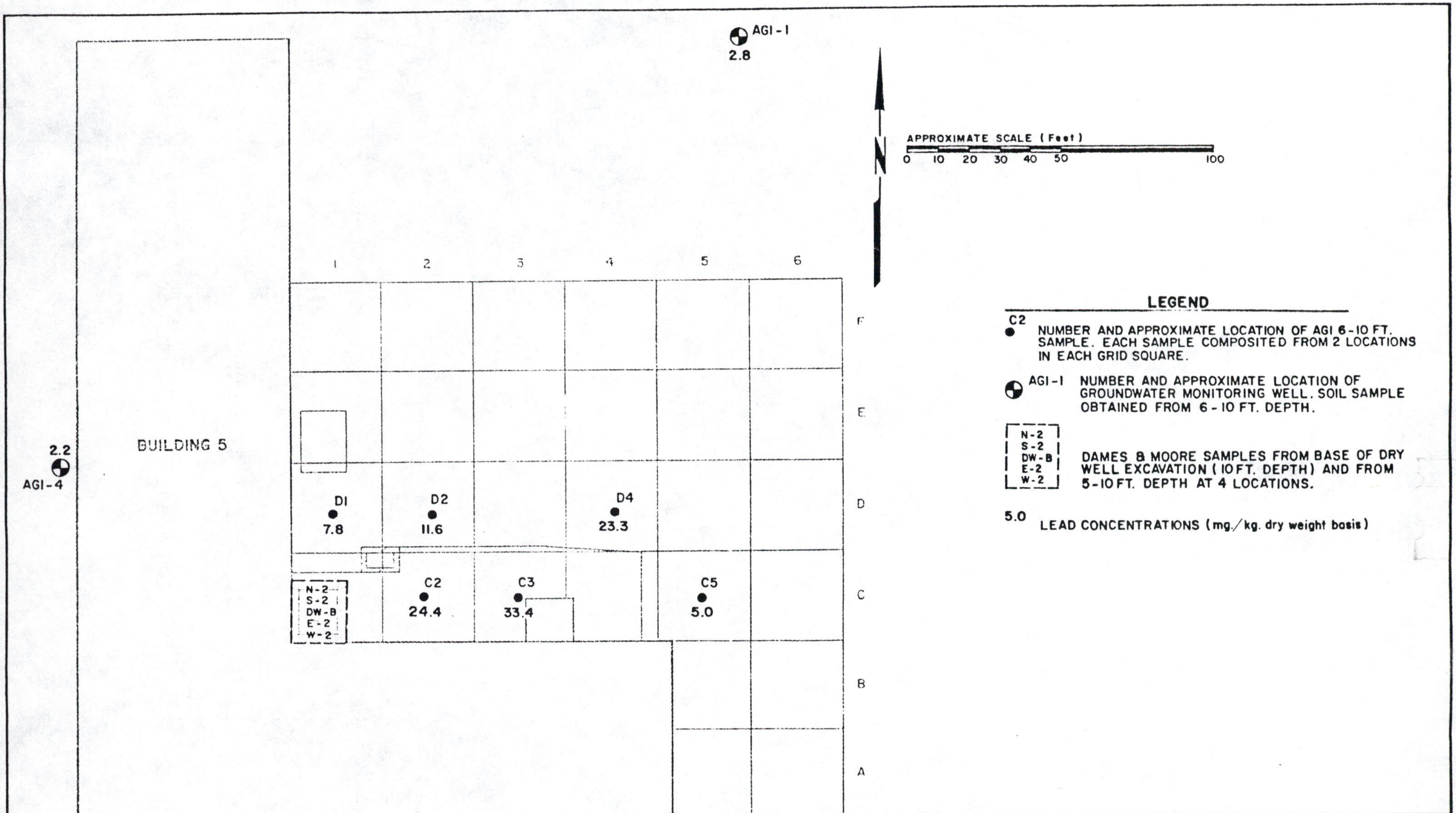
JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		

TABLE 10
ANALYTIC RESULTS: 6-10 FOOT SOILS

Sample Number [1]	% Moisture	Total Lead (mg/kg dry weight basis): Sample	Total Lead (mg/kg dry weight basis): Laboratory Duplicate	Total Lead in Rinsate (mg/l)
Waste Disposal Area				
C2 (6-10')	9.41	24.4		
C3 (6-10')	21.2	33.4		
C5 (6-10')	20.5	5.0		
D1 (6-10')	21.5	7.8	6.3	
D2 (6-10')	22.4	11.6		
D4 (6-10')	18.7	23.3		L/0.002 [2]
Background				
AGI-1 (6-10')	9.60	2.8		
AGI-2 (6-10')	5.06	15.7		
AGI-3 (6-10.5')	19.3	6.8		
AGI-4 (6-10.5')	12.1	2.2		
Drywell Samples				
W2	-	470		
N2	-	86		
E2	-	151		
S2	-	260		
DW-B	-	466		

Notes:

1. Sample locations shown on Plate 18. Samples C2 through D4 and AGI-1 through AGI-4 are composites from the indicated depth range, generally 6 to 10 feet. Samples W2 through S2 are assumed to be discrete locations from within the 5 to 10 foot depth range. Sample DW-B is from a depth of 10 feet.
2. Rinsate obtained after sampling D4 (6-10'). L/ indicates less than.



Applied Geotechnology Inc.
Geotechnical Engineering
Geology & Hydrogeology

LEAD CONCENTRATIONS: 6 TO 10 FEET

Building 5, Columbia Industrial Park
Vancouver, Washington

PLATE **18**

JOB NUMBER	DRAWN	APPROVED	DATE	REVISED	DATE
15,103.001	LDS	MAA	10-8-86		